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TACTICAL WHEELED VEHICLE FLEET REQUIREMENTS

ACN 62072

FINAL REPORT

VOLUME II: MAIN REPORT - PHASE 1

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UNITED STATES ARMY
TRAINING AND DOCTRINE COMMAND

TACTICAL WHEELED VEHICLE FLEET REQUIREMENTS

Volume II: MAIN REPORT - ~~PHASE I~~

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FINAL DRAFT

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ACKNOWLEDGEMENT

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The conclusions and recommendations of the study are those of the Commandant of the Transportation School and are based on information gathered and analysis done by the Transportation School in coordination with USATRADOC schools and agencies, with DADCSOPS and DADCSRDA and with USADARCOM.

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ABSTRACT

This is a Department of Army directed study designed to answer the question on tactical wheeled vehicle fleet composition and requirements as posed by the House Appropriations Committee of the United States Congress. The methodology used the automated procedures established throughout the Army for defining requirements and developing procurement programs. These procedures are applied to eight alternative vehicle fleets and the results are compared to a base case to establish the preferred alternative.

CHAPTER 1

INTRODUCTION

1-1. BACKGROUND. Since the Army Special Analysis of Wheeled Vehicles Study (WHEELS) in 1972-1973, Congress has questioned the Army concerning the implementation of study recommendations. As yet, the Army has not adequately explained to Congress the reasons why the Authorized Acquisition Objective (AAO) has fluctuated between and within the various weight classes of vehicles. Until recently, the Army has not had a system to capture the prime causes of the changes in vehicle requirements. This is now being developed. Since the completion of the WHEELS study, the Army force structure has changed significantly due to the introduction of modern weapons systems and the addition of three new combat divisions.

1-2. STUDY DIRECTIVE. In response to questions from the Secretary of Defense and the House Appropriations Committee, the Secretary of the Army directed that a zero-based study of tactical wheeled vehicle requirements be conducted. As a result of this guidance, Headquarters, Department of the Army (HQ, DA), directed the US Army Training and Doctrine Command (USATRADOC) to conduct a study to examine tactical wheeled vehicles in terms of fleet composition and vehicle quantities. HQ, TRADOC subsequently directed the US Army Transportation School (USATSCH) to be the study agency under the supervision of the US Army Logistics Center (USALOGC). The Army plans to use the Tactical Wheeled Vehicle Fleet study, after it has been approved, as the starting point of an audit trail of tactical wheeled vehicle requirements. The TRADOC Tactical Wheeled Vehicle Requirements Management Office (TWVRMO) is finalizing the methodology to provide periodic snapshots of the tactical wheeled vehicle requirements to provide the audit trail between budget years.

1-3. STUDY OBJECTIVES. The study was done to accomplish the following objectives:

a. Determine the payload categories and types of tactical wheeled vehicles which would best meet the needs of the Army.

b. Prepare an acquisition program to include specification of the number, type, and cost of vehicles required to transition from the existing fleet to the preferred fleet.

c. Develop an implementation schedule to align current requirements documents, Table of Organization and Equipment (TOE) and Basis of Issue Plans (BOIP), with study results.

1-4. SCOPE. The study was planned as a two-phase analysis of tactical wheeled vehicle requirements.

a. Phase I (to be completed by 1 Oct 80).

(1) The study considers current TOE and BOIP (new equipment but not new organizations) for which a defined Army master force structure need (active and reserve) exists through 1986. Requirements of the 1986 master (programed) force, as opposed to the current force, allow determination of a preferred vehicle fleet for which a transition plan can be developed and costed.

(2) The study considers the numbers and costs of tactical wheeled vehicles authorized by Tables of Distribution and Allowances (TDA) and Modification TOE (MTOE) in describing alternative fleets quantitatively. The rationale for this is that TDA and MTOE are the authorization documents used to determine the numbers of vehicles to be procured, whereas, TOE are the requirements documents used to determine the types of vehicles required by the Army.

(3) The study considers the current vehicle fleet along with planned acquisitions and projected losses as determined by US Army Development and Readiness Command (USADARCOM).

(4) The study considers the currently defined FY 86 Army master force as portrayed in the Force Accounting System (FAS) and Total Army Analysis (TAA) 86.

b. A strategic mobility analysis of selected alternatives, Phase I Addendum, will be accomplished by 15 January 1981.

c. Phase II, to be completed by 1 May 1982, will examine requirements for tactical wheeled vehicles in developmental organizations as documented in Army 86 studies.

1-5. LIMITS.

a. The study does not analyze current or projected force structure requirements except as they relate to tactical wheeled vehicle needs.

b. The study does not analyze structuring of TOE's except for tactical wheeled vehicles required by TOE/BOIP.

c. The study does not analyze MTOE, TDA, and generated requirements for types of vehicles except as the number of vehicles authorized impacts on fleet quantities and costs.

1-6. ASSUMPTIONS.

a. The number of TOE units required by the Army is established by the Army master force.

b. Except for tactical wheeled vehicles, the TOE/BOIP for units of the Army are valid for the purpose of this study.

c. The kinds of vehicles to be found in the proposed fleet can be determined by considering only the requirements which are derived from the needs of TOE units, as opposed to TDA and MTOE organizations.

d. The divergence of MTOE authorizations for tactical wheeled vehicles from TOE/BOIP requirements can be quantified and factored into alternative tactical wheeled vehicle fleets.

e. US Army Training and Doctrine Command-approved Standard Requirement Codes/Automated Unit References (SRC/AURS) for Army 86 represent valid organization and doctrine for phase II of the study.

1-7. ESSENTIAL ELEMENTS OF ANALYSIS. Answers to the following questions were considered to be the key to development of study results and are discussed in chapter 9.

a. What quantities and mix of tactical wheeled vehicles are required for mission accomplishment?

b. What are the development, procurement, and operating costs for 20 years of fleet operations?

c. Which alternative fleet will accomplish the mission at least cost?

d. What is the preferred fleet of wheeled vehicles to satisfy the Army's needs based on present organizations? Based on Army 86?

e. For each vehicle type in the preferred fleet, what is the quantity required and the time phasing necessary to replace existing vehicles in the current fleet as they exceed age/condition criteria for retention?

f. What acquisition strategy/plan can be developed to support the preferred fleet?

g. What is the implementation schedule needed to change requirements and authorization documents to reflect study results?

1-8. METHODOLOGY. The study develops equally effective, alternative tactical wheeled vehicle fleets for the Army and compares the 20-year program cost and manpower requirements for the alternative fleets. The detailed steps in the methodology are summarized in figure 1-1.

a. First, TOE proponents (i.e., Infantry School, Armor School, Academy of Health Sciences, etc.) analyzed tasks requiring tactical wheeled vehicles.

b. The results were formatted as BOIP changes by TRADOC.

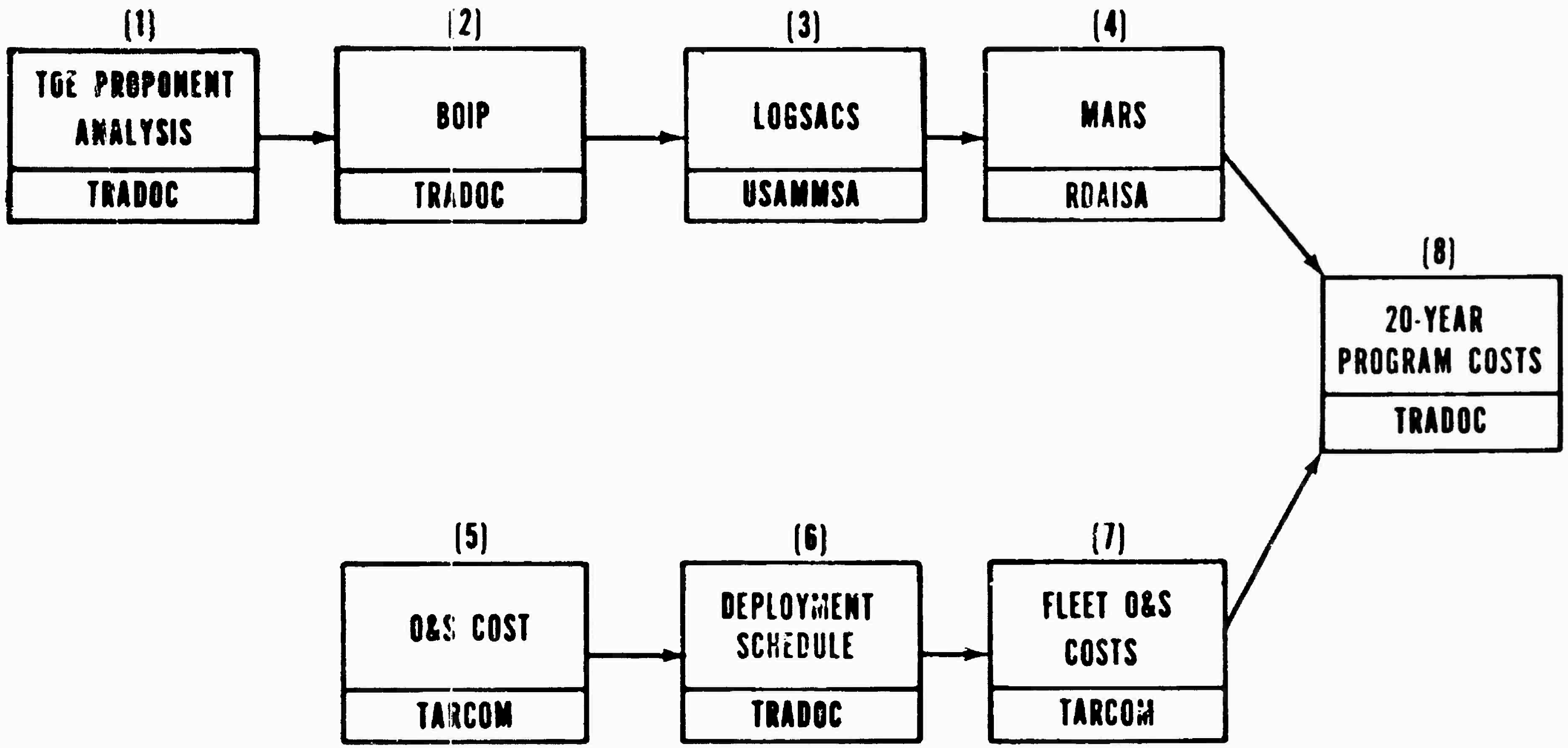

Figure 1-1. Methodology.

c. The BOIP changes were applied to the force structure authorization for equipment maintained in the Logistics Structure and Composition System (LOGSACS).

d. The resulting force structure authorizations for tactical wheeled vehicles were used in the Materiel Readiness System (MARS) to determine AAO which consists of force requirements, TDA requirements, Prepositioning of Materiel Configured to Unit Sets (POMCUS), special projects and contingencies, wartime consumption, mobilization training losses and wartime active replacement--special allies.

e. Concurrent with the steps described above, Operating and Support (O&S) costs were developed for each vehicle by TARCOM.

f. Deployment schedule data was developed by TRADOC based on distribution of assets.

g. O&S costs for the fleet were calculated.

h. Lastly, fleet O&S costs were combined with fleet procurement and development costs to determine the total cost of the tactical wheeled vehicle fleet over a 20-year period.

1-9. DATA BASES FOR STUDY. The data used by the study includes:

a. TOE current as of 6 May 1980.

b. HQ TRADOC-approved BOIP as documented in TRADOC BOIP summary BPP26RL (6 May 1980).

c. The Army master force as documented in the Logistics Structure and Composition System (April 1980).

d. Tactical wheeled vehicle asset status provided by DARCOM, current as of 30 September 1979.

e. Cost data provided by DARCOM, current as of 31 July 1980.

CHAPTER 2

ANALYSIS OF CONSTRAINTS, ASSUMPTIONS, AND LIMITS

2-1. INTRODUCTION. This chapter presents the analysis of constraints, assumptions, and limits placed by study alternatives. The validity of study results depends on assumptions used, and the use of these study results must consider the limits within which they are valid. Resolution of differences between alternatives and completeness of the set of alternatives is impacted by constraints on alternatives. Analysis of assumptions, limits, and constraints previously listed in chapter 1 is continued here.

2-2. CONSTRAINTS. The following constraints were used in the study to define and limit the alternatives considered.

a. Elimination of 1/2-Ton MULE and 8-Ton GOER. Because some of the vehicle payload categories are no longer required (they are substitute items in some cases), or because there are only a few vehicles remaining in the inventory, and action is being taken to eliminate those vehicles from the fleet, the study group (in coordination with DARCOM) reduced the number of body styles of vehicles to be considered as requirements from 186 to 90 and in the process reduced the number of payload categories of trucks from 7 to 5. Two payload categories, the MULE and the GOER, were eliminated.

b. Inclusion of 10-ton truck in each alternative mix. Based on the TRADOC-approved BOIP for a 10-ton truck (HEMTT) and supporting COEA (TACV Addendum), there is a validated requirement for the 10-ton truck in the Army to support Pershing II, Multiple Launch Rocket System (MLRS), Patriot, and the major users of ammunition (artillery, armor and mechanized infantry). Recognition of this requirement means that a 10-ton truck would be included in any alternative fleet.

c. Truck-Tractors. The retention of five truck-tractors in each alternative fleet was based on their specialized capability and is justified by the following rationale:

(1) The M915 line haul truck-tractor was designed to pull semitrailer loads (containerized and break-bulk) weighing up to 34 short-tons (STONS).

(2) The M878 yard tractor was designed to quickly move trailer loads in support of port operations. This vehicle, required by the transportation terminal service company, has a hydraulic fifth wheel which eliminates the need to manually raise and lower trailer legs.

(3) The M916 light equipment transporter (LET) and the M920 medium equipment transporter (MET) were designed to transport light and medium engineer construction equipment.

(4) The M911 heavy equipment transporter (HET) was designed to transport the main battle tank (60 STONS).

d. Affordability. In order to compare the resource requirements of fleet mix alternatives on an effectiveness basis, the study analyzes fleet mix alternatives at full AAO even though it is unlikely that the AAO will be procured with current fiscal limitations. This study best supports the Planning, Programing, and Budgeting System (PPBS) process by providing a complete picture of the Army's needs for tactical wheeled vehicles from which the impact of constrained resources can be measured.

2-3. ASSUMPTIONS. The following assumptions were made in accomplishing the study:

a. The current and projected Army master force establishes a valid requirement for the number of type units required by the Army. Specifically, the Army master force outlined in the FAS, dated April 1980, was used.

b. The TOE/BOIP for type units (i.e., tank companies, artillery batteries, etc.) of the Army are valid for purposes of this study except for tactical wheeled vehicles. The intent of this assumption is to assure that this study be limited to a study of vehicles for Army units rather than a far reaching study of the organization of the units of the Army.

c. The kinds of vehicles to be found in the proposed fleet can be determined by considering only the requirements which are derived from the needs of TOE units, as opposed to TDA and MTOE organizations. TDA organizations are authorized mostly administrative vehicles of kinds not to be examined in this study. The small numbers of tactical wheeled vehicles used in TDA units are not based on the requirements of TDA organizations but are selected from the Army inventory; therefore, their use in the TDA units need not be considered when selecting the kinds of vehicles to be found in the preferred fleet.

d. The divergence of MTOE authorizations for tactical wheeled vehicles from TOE/BOIP requirements can be quantified and factored into alternative tactical wheeled vehicle fleets. MTOE authorizations vary the number of vehicles authorized by TOE according to theater special needs, but do not establish a requirement for type vehicles. The purpose of this assumption is to permit a timely analysis of the Army's worldwide need for tactical wheeled vehicles by October 1980 based on the requirements documented in approximately 700 TOE with BOIP while accounting for variances in authorization due to the approximately 8,000 MTOE/TDA organizations in the Army.

2-4. STUDY LIMITS.

a. The study does not analyze current or projected force structure (unit) requirements.

b. The study does not analyze structuring of TOE's except for tactical wheeled vehicles required in TOE/BOIP.

c. The study does not analyze MTOE requirements nor TDA requirements except as the number of vehicles impact on fleet quantities and costs.

d. The study focuses on projected (1986) requirements in order to develop a modernization plan.

e. The study uses the existing Army requirements and acquisition data bases in order to compare alternative fleets. Study results, therefore, may be used to support tactical wheeled vehicle requirements in the Program Objective Memorandum (POM).

f. The study does not determine:

(1) Tactical wheeled vehicle useful life.

(2) The cost-effectiveness of tactical wheeled vehicle rebuild versus replacement vehicle procurement policies.

(3) Priorities of distribution of new or replacement equipment.

g. The study does not dictate structure of specific TOE's with regard to the functions to be performed by tactical wheeled vehicles. HQ TRADOC, on recommendations of the TOE proponent agency, is responsible for approving TOE changes.

h. The study does not develop or establish the need for new tactical wheeled vehicle types and models. The study uses cost data for developmental vehicles and for new procurement of types presently in the fleet.

2-5. SUMMARY.

a. The constraints eliminate the 1/2-ton MULE and the 8-ton GOER and establish the need for a 10-ton truck.

b. The assumptions provided a basis for examination of tactical wheeled vehicle requirements from the unit level to fleet requirements. Changes in the number of units in the Army can be expected to impact the number (but not the type) of vehicles needed. Significant changes in the unit organization, missions, and doctrine could change the Army's requirement for types of vehicles. The study incorporates the impact of known changes up to 1986. The ongoing Army 86 study does not establish requirements for new types and payload categories of vehicles but may impact numbers of vehicles needed. The second phase of the study will focus on requirements generated by the Army 86 study to better define tactical wheeled vehicle requirements after 1986.

c. The study limits permit accomplishment of stated study objectives. Some loss of accuracy is expected due to the extrapolation of table of organization and equipment data from initial issue quantities to full authorized acquisition objectives. Consistent application of the limits to each alternative fleet permitted a fair comparison of alternatives. No loss of accuracy is expected in determining the types and payload categories of vehicles needed.

CHAPTER 3

MISSION NEEDS

3-1. INTRODUCTION. The purpose of this chapter is describe development of the Army's requirement for tactical wheeled vehicles. The Tables of Organization and Equipment (TOE), which specify personnel and equipment needed by type units to accomplish the unit mission, is the keystone in the development of the number of tactical wheeled vehicles needed by the Army. In chapter 4, the requirement for tactical wheeled vehicles will be extended to the total Army requirement which is expressed as the Authorized Acquisition Objective (AAO).

3-2. DEVELOPMENT OF ALTERNATIVES.

a. The following seven different weight classes of trucks are now in use by the US Army: 1/4-T, 1/2-T, 5/4-T, 2 1/2-T, 5-T, 8-T, and 10-T which constituted the starting point for requirement development. Within each weight class, there are numerous variations as regards body, type, special equipment, etc.

b. The Training and Doctrine Command (TRADOC) study group developed an evaluation strategy which was both comprehensive and yet manageable. This allowed the number of fleet mixes to be evaluated to be reduced to 9 from the potential of 127 that could be developed from seven payload categories. A synopsis of this strategy is as follows:

(1) The 8-ton GOER was eliminated as it is no longer planned for procurement.

(2) The 1/2-ton M274 (MULE) was eliminated as both the US Marine Corps and the Army have determined that this special purpose payload category should not be retained.

(3) The 10-ton truck (HEMTT) will appear in all alternative fleet mixes.

(4) The remaining set of vehicles to be considered were placed into two groups for which there are distinct Army needs:

(a) Group A (command and control, light cargo) consists of 1/4- and 5/4-ton vehicles.

(b) Group B (prime movers and intermediate cargo) consists of 2 1/2- and 5-ton vehicles.

(5) Some of the requirements (light cargo) for vehicles in group A could be met using vehicles from group B, but this would be inefficient. Many of the towed loads requiring a vehicle prime mover from group B could not be pulled by 1/4- or 5/4-ton vehicles. Use of the

10-ton vehicle to perform payload independent tasks such as prime mover or shelter transport tasks, currently required of 2 1/2- and 5-ton trucks, is inefficient. This rationale allows further reduction of the mix alternatives according to the rule that a mix alternative must contain at least one vehicle from each of groups A and B.

(6) The nine mix alternatives retained for consideration are:

Mix Alternative		Truck Weight Class (TON) Group A		Group B		
1	Base Case	1/4	5/4	2 1/2	5	10
2		-	5/4	2 1/2	5	10
3		1/4	-	2 1/2	5	10
4		1/4	5/4	-	5	10
5		1/4	5/4	2 1/2	-	10
6		1/4	-	-	5	10
7		-	5/4	2 1/2	-	10
8		1/4	-	2 1/2	-	10
9		-	5/4	-	5	10

3-3. ANALYSIS OF TOE TASKS REQUIRING TACTICAL WHEELED VEHICLES. Analysis of TOE requirements for tactical wheeled vehicles was accomplished by the 20 schools/centers responsible for developing and documenting TOE. A list of those agencies and the TOE, designated by Standard Requirement Code (SRC) number, are in appendix B. The analysis began with a conference at Fort Eustis and concluded when the TOE proponent agencies had satisfied the study group that they had followed the established guidelines and directions.

3-4. PROPONENT AGENCY GUIDANCE AND DIRECTION. A TOE proponent agency conference was conducted at the Transportation School to orient proponent agency representatives on the methods of analysis of TOE task requirements of trucks. The conference attendees were provided a study plan briefing, a briefing on the master force and Basis of Issue Plan (BOIP) a briefing on the vehicle fleet and, lastly, a working session using TOE and the rules and guidance for task analysis from the study plan.

a. Rules:

(1) Maintain a capability to do the job equal to the base case.

(2) Choose the least number of vehicles to do the job for payload dependent tasks such as ammunition haul.

(3) Choose the smallest payload category vehicle where the task is payload independent, such as command and control.

(4) Use trailers to the maximum extent feasible consistent with unit mission.

(5) Combine tasks where feasible.

b. TOE guidance included the following:

(1) Level 1 requirements for vehicles would be analyzed. (This is the authorization level required for combat operations.)

(2) Current TOE (as of 6 May 80) would be analyzed.

(3) BOIP changes as documented in the TRADOC automated BOIP summary, BPP26RL, 6 May, were applied to establish the base case for the study. Prior to analysis of alternative mixes of vehicles, the TOE proponent agencies applied TRADOC-approved BOIP to their TOE to account for changes in tactical wheeled vehicle requirements due to emerging weapons systems and other new equipment programed for the Army. The resulting "base case" reflects the personnel and equipment requirements for Army units in 1986. A total of 450 BOIP were applied including those for the XM1 tank, the Infantry Fighting Vehicle (IFV), and Cavalry Fighting Vehicle (CFV).

(4) Augmentations to TOE would not be analyzed but cellular teams (with SRC) must be analyzed.

c. Equipment guidance included the following:

(1) Generated requirements for vehicles did not have to be analyzed by TOE proponents. These items were to be counted later in the study (see chap 4) so that the number and cost of vehicles could be determined.

(2) One-half ton MULE vehicles will be replaced in the base case by a suitable 1/4-ton or 1 1/4-ton vehicle as determined by the TOE proponent.

(3) The following guidance to TOE proponent agencies for incorporating the High Mobility Multipurpose Wheeled Vehicle (HMMWV) in the study alternatives was provided. Those units normally operating forward of the division rear boundary plus those units with a rear area combat operation reactions force mission (e.g., military police) or those units having a weapons systems requiring mobility must be equipped with tactical 5/4-ton vehicles (HMMWV). Other requirements for 5/4-ton vehicles would be filled by an M880 type truck.

(4) Similarly, 8-ton GOER vehicles will be replaced by a suitable 5- or 10-ton vehicle as per the 10-ton Heavy Expanded Mobility Tactical Truck (HEMTT) BOIP.

3-5. PROPONENT DEVELOPMENT OF ALTERNATIVE DATA. The detailed procedures used by all the schools is illustrated using a worksheet from the US Army Infantry School. Table 3-1 is an extract of portions of the worksheet used for the TOE for Headquarters and Headquarters Company (HHC), Mechanized Infantry Battalion.

a. The heading of the worksheet identifies the HHC, Mechanized Infantry Battalion by SRC number 07046H020 with the proponent being the US Army Infantry School and indicates that there are 113 of these units in the master force.

b. The column headings identify the paragraph number in the TOE in which vehicle requirements are indicated, the tasks to be accomplished, the task codes used for data processing purposes, and the nine alternative mix columns for indicating vehicle choices.

c. The coding on the sample worksheet for the column entries for the base case and alternative mixes 2 through 9 is shown by the following example:

Vehicle Line Item Number	Payload Category	Type Vehicle	Quantity	Number of Drivers Primary Duty	Number of Drivers Additional Duty
X40009	2.5	K (Truck) R (Trailer) C (Tractor)	1	0	1

d. The first line shows that command and control tasks in Mix 1 (base case), have 1/4-ton trucks, two each, using one primary duty driver and one additional duty driver. In Mix 2, they are replaced by two each, 5/4-ton trucks also with a primary and additional duty driver. On the second line, the 1/4-ton trailers are no longer needed when the 5/4-ton truck replaces the 1/4-ton truck.

e. The third line shows the unit supply truck, one 2 1/2-ton with no primary duty driver and one additional driver that is replaced by a 5-ton truck in Mix 4 on a 1-for-1 basis. The comment "Same (1)", used in Mixes 2, 3, and 5 columns, indicates that the vehicle shown in Mix 1 is also used in that mix.

f. The fourth line shows a communications platform task performed by a 1 1/4-ton truck with one additional duty driver and is replaced by two each, 1/4-ton trucks with two additional duty drivers in Mix 3. Further, line 5 shows a requirement for two each, 1/4-ton trailers to complete the accomplishment of this task.

g. Lines 6 and 7 show ammunition transport tasks accomplished by five 5-ton trucks, each with a primary duty driver and three 1 1/2-ton

Table 3-1. Sample Worksheet

[illegible]20 (a) — SRC

USA Infantry School (b) — Proponent Center/School

113 (c) — Number of SRC's in Master Force (For Study Group use only)

TOE Analysis

[illegible] SECTION III, Para No. (d)	TASK (e)	CODE (f)	MIX 1	MIX 2	MIX 3	MIX 4	MIX 5	REMARKS
[illegible]	Cmd/Control	G04	X60833, .25, K,2,1,1	Z94109, 1.25 K,2,1,1	Same (1)	Same (1)	Same (1)	
03	Pers Cargo	A10	W9540C, .25, K,2,0,0	NA1	Same (1)	Same (1)	Same (1)	
02	Supply Co	A10	X40005,2.5, K,1,0,1	Same (1)	Same (1)	X40794, 5,K,1,0,1	Same (1)	
04	Communications	G05	Z94109,1.25, K,1,0,1	Same (1)	X60833, .25, K,2,0,2	Same (1)	Same (1)	
04	Communications	G05	NA	NA	W95400, .25,R,2,0,0	NA		
06	Ammunition	A05	X40794,5, K,5,5,0	Same (1)	Same (1)	Same (1)	Z93547, 10,K,5,5,0	Trucks required to support cross attached units
06	Ammunition	A05	X95811,1.5, K,1,0,0	Same (1)	Same (1)	Same (1)	NA2	

NA-1. Pers eqp carried in c/c 5/4T para 01

NA-2 Payload carried in ammunition 10-T para 06 trailers. In Mix 5, the task is accomplished by five each 10-ton trucks, each with a primary duty driver. Remarks indicate that five trucks are required because elements of the unit must be accompanied by their ammunition basic load when they are cross-attached with a tank unit, for example, the NA^2 note identifies the reason that the 1 1/2-ton trailers are not required for Mix 5.

3-6. QUALITY CONTROL.

a. While the proponent schools were working on the development of alternative input data, a quality control team from the study group visited selected TOE proponents. The purpose of these visits was to ensure that the guidance for the input data was being strictly adhered to.

b. Subsequent analyses of TOE by proponent agencies was staffed and approved by the school commandants and agency commanders prior to submission to the study group.

(1) Each TOE submitted by the proponent school/center was checked against the master list of SRC scheduled to be in the FY 86 Force Accounting System (FAS) to ensure that all TOE in the FAS were analyzed by the responsible proponent.

(2) TOE worksheets were checked for format, to include proper Line Item Number (LIN), codes, and identification of primary and additional duty drivers.

(3) TOE worksheets were further checked to see if the rules and guidance for selecting alternative vehicles/trailers were followed and that reasonable explanations were provided in those cases where vehicle selection was contrary to the set rules and guidance (i.e., retention or selection of a vehicle/trailer that was not under consideration in a particular alternative).

3-7. SUMMARY:

a. Although the possible mathematical combinations of the Army's seven weight classes of trucks total 127, applied logic narrowed to nine, the number of mix alternatives analyzed.

b. These nine mix alternatives were analyzed by the 20 proponent schools for the 700 plus tables of organization and equipment that require tactical wheeled vehicles. This required the manual analysis of approximately 8,000 tasks across the total table of organization and equipment structure.

c. The study group developed a quality control mechanism that included follow-through inspections and a reporting feedback procedure that provided enhanced credibility for the study.

d. The table of organization and equipment analysis by proponents resulted in vehicle replacement ratios that came close to 1-for-1 between the alternative mixes.

CHAPTER 4

DEVELOPMENT OF FLEET MIX ALTERNATIVES

4-1. INTRODUCTION. The purpose of this chapter is to describe the methodology used in the study to expand the results of Tables of Organization and Equipment (TOE) analysis, described in chapter 3, into the total Army requirement and procurement program for tactical wheeled vehicles for each fleet mix alternative. The charts in figures 4-1 through 4-3 illustrate the process discussed in this chapter.

4-2. DEVELOPMENT OF FORCE REQUIREMENTS (fig 4-1). The Army process of development of force requirements for tactical wheeled vehicles is identified in the figure by solid lines. The process starts with analysis of TOE requirements to determine the types (payload categories) of vehicles needed by the Army. A manual update of TOE was done to account for the tactical wheeled vehicle requirements impact of emerging weapons systems and organizational changes planned through 1986. Generated requirements, for example, compressors which are required to be mobile and are mounted on trailers, were counted but were not task analyzed. The numbers of vehicles needed are determined from the modified TOE authorization documents used by Army units in the field multiplied by the number of units in the force structure corresponding to those Modification TOE (MTOE). MTOE are routinely changed by Basis of Issue Plan (BOIP) to account for new or replacement equipment items. As indicated by the dashed arrow, the study group, in coordination with proponent agencies, did manual updating of TOE and used BOIP formats to configure the Army's authorization for tactical wheeled vehicles to the alternatives studied.

4-3. DEVELOPMENT OF THE AUTHORIZED ACQUISITION OBJECTIVE (AAO) (fig 4-2). The second step in determining the Army's requirement for tactical wheeled vehicles is shown by the solid lines in the figure. The Force Requirement for tactical wheeled vehicles is extended to the Initial Issue Quantity (IIQ) by adding Tables of Distribution and Allowance (TDA) authorizations. Special project and contingency requirements were added. Operational readiness floats, wartime consumption and mobilization training losses were factored and added to the IIQ. Lastly, wartime active replacement stocks for special allies were added. The result is the AAO. The dashed lines indicate that the study group configured TDA and MTOE residual authorizations (differences between TOE and MTOE) to the alternative mixes studied. Nine AAO's corresponding to the nine alternatives were calculated in this manner.

a. The Operational Readiness Float (ORF) is computed by multiplying the active vehicle quantity by ORF Factor, a factor based on maintenance requirements to insure that units have vehicles to replace those that are down for extensive maintenance.

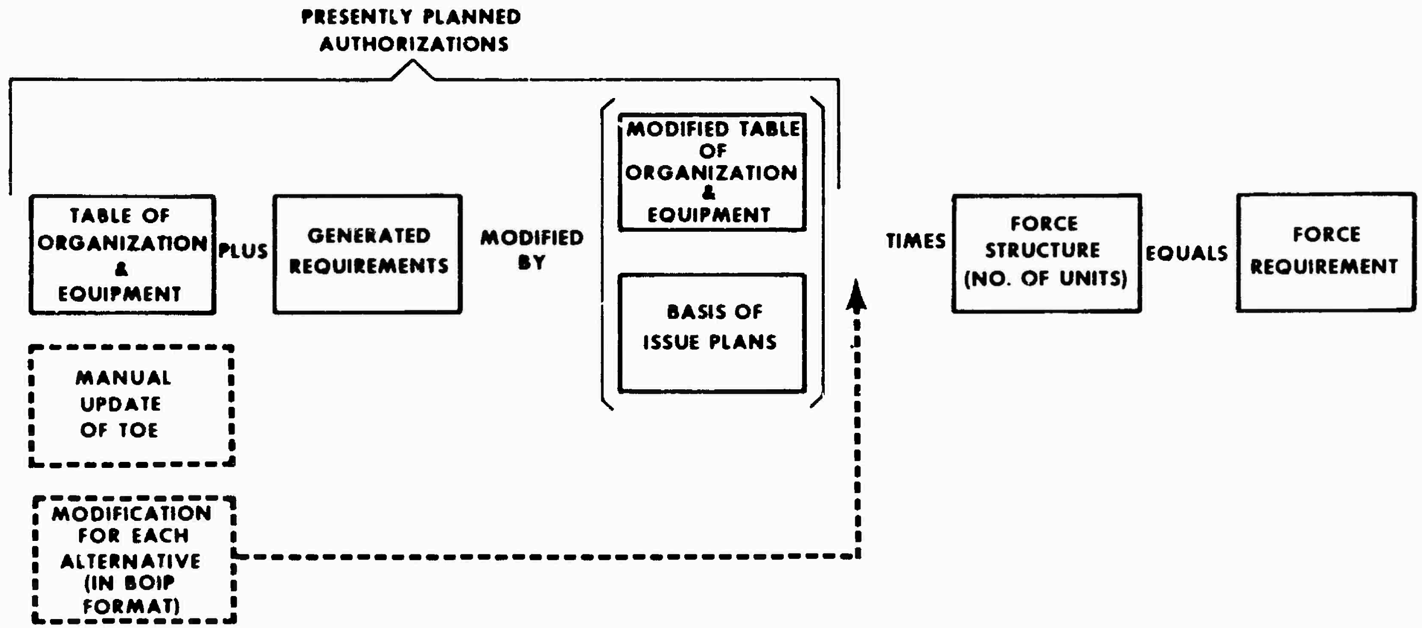

Figure 4-1. Development of force requirement.

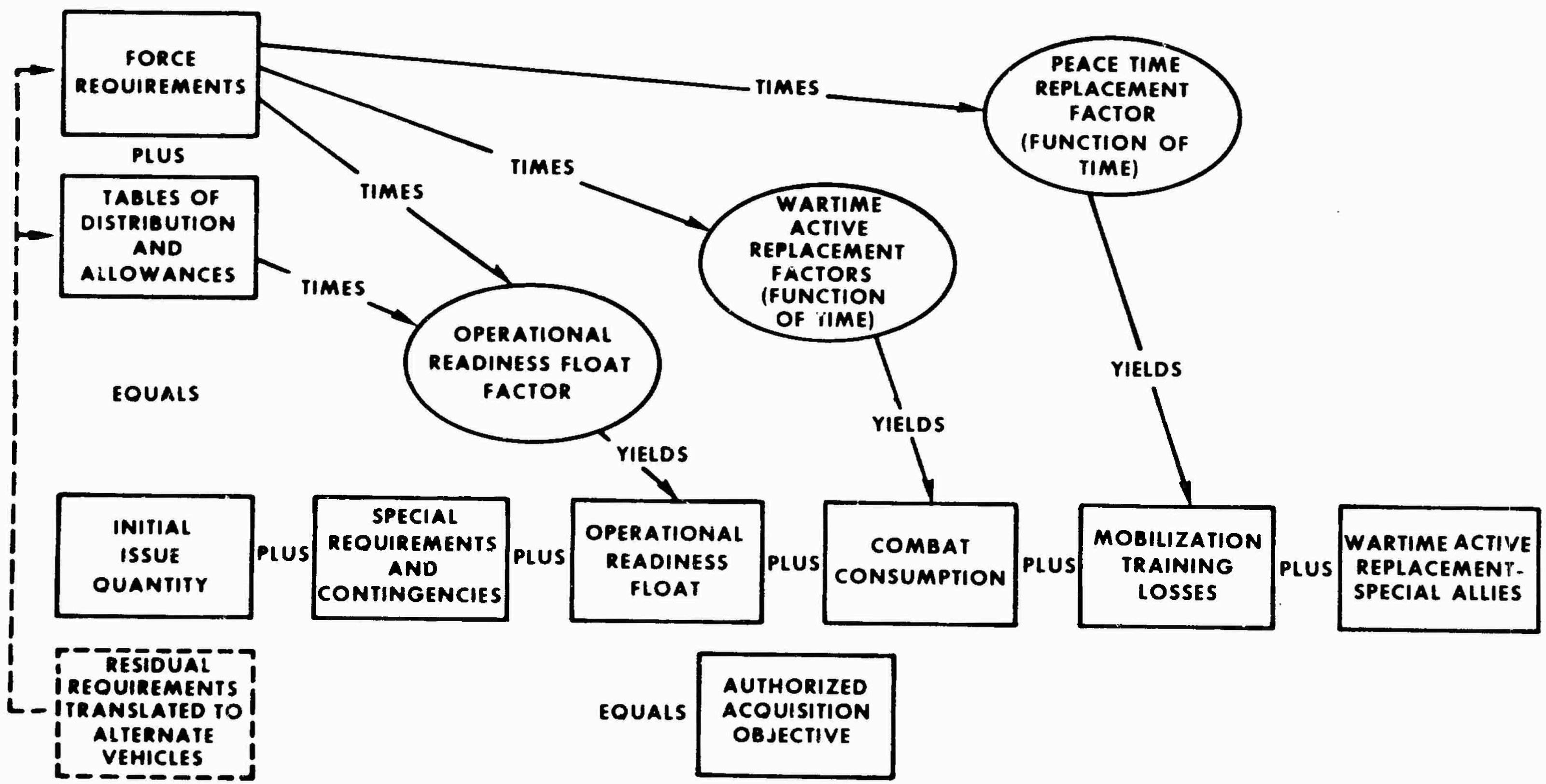

Figure 4-2. Development of the authorized acquisition objective (AAO).

b. Projected combat consumption requirements are computed by multiplying by Wartime Active Replacement Factors (WARF) that portion of the active force which can be anticipated to be engaged. The WARF used in this study were based on those used as input to the FY 81-85 and FY 82-86 Program Objective Memorandum (POM) which were based on the Ammo P-85/WARF-85 study completed by the Concepts Analysis Agency in December 1978. The Ammo P-85/WARF 85 study examined a non-nuclear conflict between NATO and the WARSAW Pact in the 1985 time frame. Certain minor differences resulted from rounding errors and correction of identifed errors in the WARF data bank. The methodology for development of WARF is based on equipment loss rates resulting from the interactions of three conditions in battle simulations:

(1) Combat posture of the force studied.

(2) Location of equipment items on the battlefield relative to the Forward Edge of the Battle Area (FEBA).

(3) Cause of loss of equipment items. Additionally, historical battle loss data and logistical loss data are combined with simulation data to calculate WARF for equipment items. A detailed description of the process, provided by DA, is in appendix O.

c. The mobilization training losses are computed by multiplying those units which will be intensively trained during mobilization by the training time and then multiplying by the peacetime replacement factor. This quantity accounts for vehicle losses due to intensive mobilization training.

d. In addition to these factors, a Wartime Active Replacement for Special Allies (WAR-SA), based upon an analysis of their requirements, is added. The total of all of these factors results in the gross requirement and AAO.

e. It should be noted at this point that the potential for procuring a portion of this requirement after initiation of combat would be subtracted from the gross requirement to obtain the AAO; however, the procurement lead-time for vehicles is such that no receipts can be expected within the first 180 days. Thus, the AAO is the same as the gross requirement, since they are both based on 180 days of requirements.

f. Development of the quantitative requirements for the 5-ton cargo truck (Standard Study Number (SSN) D14002) is shown in table 4-1. Note that the quantity shown as "Force Requirement" is the sum of the requirements for each unit in the FY 86 force structure. The portions contributed by generated requirements, MTOE, and BOIP are shown for clarity.

4-4. RESIDUAL REQUIREMENTS. During the generation of requirements for the various alternatives, a limited number of requirements remained for

Table 4-1. Development of the AAO for the 5-Ton Cargo Trucks for All 5-Ton Vehicles

Alternative 1 - Base Case

TOE	11,055	
Generated Requirements	108	
MTOE	1,564	
BOIP	- 1,035	
Force Requirements		11,692
TDA		213
POMCUS	(4,166)	0
Initial Issue Quantity (IIQ)		11,905
Special Requirements and Contingencies		3
Operational Readiness Float		513
Combat Comsumption and Mobilization Training		10,338
War Reserve, Special Allies		298
AAO		23,057

Total AAO for 5-Ton Truck Family

Cargo	23,057
XLWB	3,320
Dump	11,530
Tractor	13,571
Tractor-Wrecker	614
Van	2,427
Wrecker	5,319
	59,838

vehicles in a payload category after that category was to have been eliminated. These requirements remain for several reasons:

a. They were MTOE or TDA requirements which were not analyzed.

b. They were generated requirements which were not analyzed.

c. The proponent agency strongly felt that the vehicle was absolutely required; for example, the combat support vehicle, XM966 (HMMWV TOW). In this case, the vehicle was left in the fleet even after removal of the 1 1/4-ton family.

These requirements were either left in the AAO (XM966), translated to a "dummy" vehicle which was created using engineering analysis to perform the required mission in an alternative payload class (see para 4-8), or were translated to an alternative vehicle such as in the case of generated requirements, TDA's and MTOE's. These translations are tabulated in table 4-2 and were based on an analysis of the shifts of which took place on the basis of TOE analysis.

4-5. DEVELOPMENT OF PROCUREMENT PROGRAM (fig 4-3). While the preceding computations were executed only once to determine the AAO for FY 86 force, the following procedures were executed for each year starting with FY 82 through FY 01.

a. The AAO is compared with the anticipated assets for each fiscal year to determine the shortage by adding to the starting assets the planned receipts in that year which would result from prior year contract and any other pending actions. From this figure, the forecast losses, due to accidents, are subtracted. These anticipated losses are derived by multiplying the peacetime replacement factor for 1 year times the lesser of either the IIQ or the assets available. The lesser of those numbers represents the actual number of vehicles which should be in use during that year. The result of this computation is the anticipated shortage which would result if no further procurement were to take place.

b. The procurement program is developed by utilizing the lesser of the shortages derived above, or the development and production constraints, which are tabulated in the program. These development and production constraints are based on the following factors:

(1) The development time required to place the Army in a position to procure the vehicle. For those vehicles which were not presently in a procurable status, a development program, or other actions as were required, were defined and the costs were tabulated in Volume III, appendixes D through L, corresponding to alternatives 1 through 9, of the study.

(2) Production constraints were developed by considering the normal industrial base for the item in question. Through in-house knowledge and historical data of that production base and, in certain

Table 4-2. Residual Requirements Translated to Alternative Vehicles

REQUIREMENT (FROM)		ALTERNATIVE (TO)	
		ALL ALTERNATIVES	
D16101	10-Ton Wrecker (GOER)	D16203	10-Ton Recovery (HEMTT)
D16102	8-Ton Cargo (GOER)	D16201	10-Ton Cargo (HEMTT)
D16103	2,500 Gal Fuel (GOER)	D16202	10-Ton Tanker (HEMTT)
D16104	8-Ton Cargo (GOER)	D16201	10-Ton Cargo (HEMTT)
D18400	1/2-Ton Utility (MULE)	D15303	1 1/4-Ton Utility (HMMWV)
D11202	1 1/4-Ton Ambulance (GAMMA GOAT)	D15302	1 1/4-Ton Ambulance (HMMWV)
D11201	1 1/4-Ton Cargo (GAMMA GOAT)	D15303	1 1/4-Ton Utility (HMMWV)
		ALTERNATIVES 2, 7, & 9	
D15101	1/4-Ton Ambulance (Jeep)	D15301	1 1/4-Ton Ambulance (HMMWV)
D15102	1/4-Ton Utility (Jeep)	D15303	1 1/4-Ton Utility (HMMWV)
		ALTERNATIVES 3 & 8	
D11103	1 1/4-Ton Cargo (M880)	D13103	2 1/2-Ton Cargo
D15303	1 1/4-Ton Utility (HMMWV)	D15102	1/4-Ton Utility
		ALTERNATIVES 4, 6, & 9	
D13103	2 1/2-Ton Cargo	D14002	5-Ton Cargo
D13104	2 1/2-Ton Cargo XLWB	D14003	5-Ton Cargo XLWB
D13105	2 1/2-Ton Dump	D14004	5-Ton Dump
D13111	2 1/2-Ton Tractor	D14006	5-Ton Tractor
		ALTERNATIVES 5, 7, & 8	
D14102	5-Ton Cargo	D16201	10-Ton Cargo (HEMTT)
D14003	5-Ton Cargo XLWB	D16201	10-Ton Cargo (HEMTT)
D14006	5-Ton Tractor	D16205	10-Ton Tractor (HEMTT)
D14009	5-Ton Wrecker	D16203	10-Ton Recovery (HEMTT)
D14010	5-Ton Cargo with Crane	D16201	10-Ton Cargo (HEMTT)
		ALTERNATIVE 6	
D11103	1 1/4-Ton Cargo (M880)	D15102	1/4-Ton Utility (Jeep)
D15303	1 1/4-Ton Utility (HMMWV)	D15102	1/4-Ton Utility (Jeep)

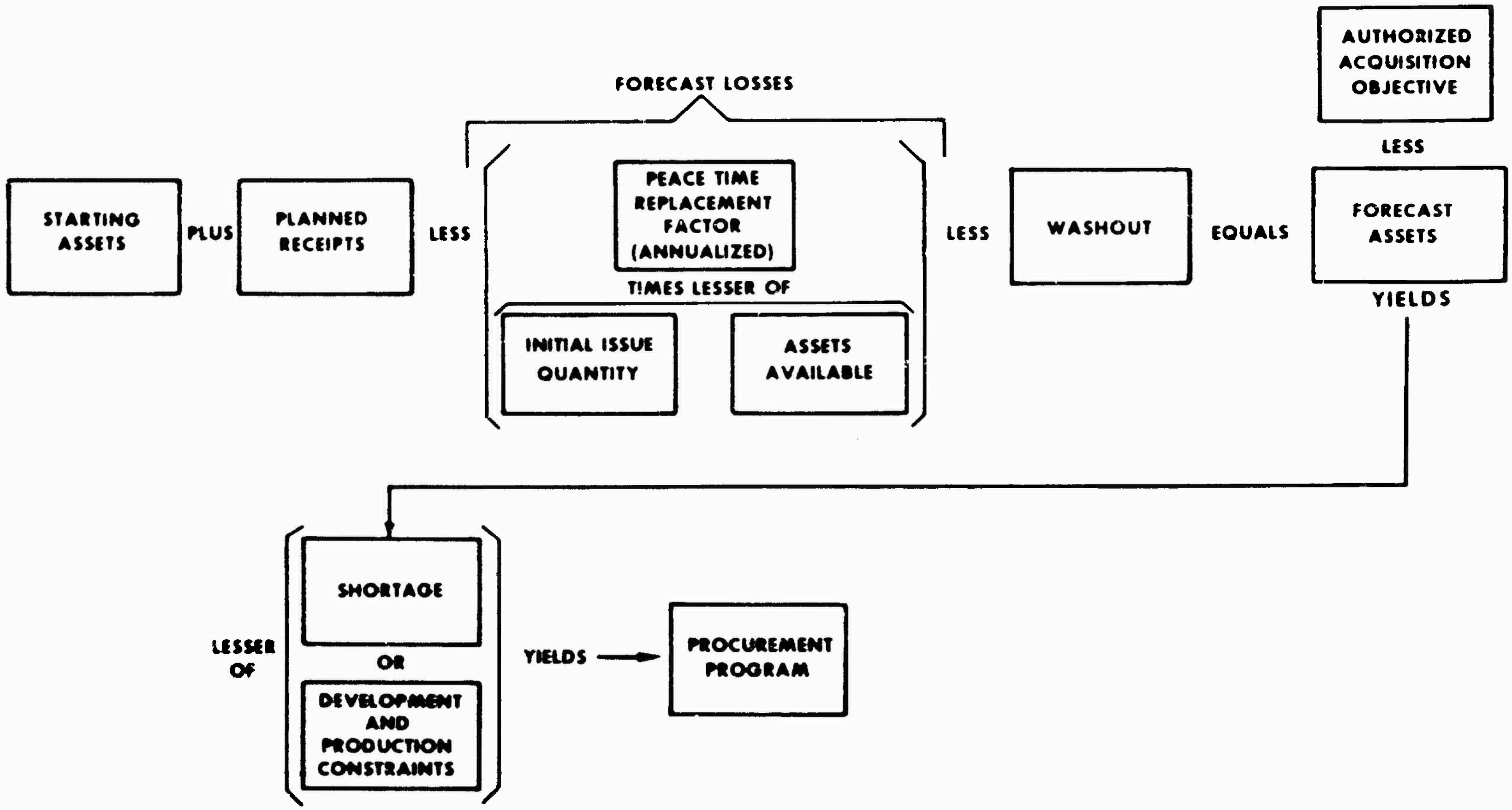

Figure 4-3. Development of procurement program.

cases, through discussions with representatives of the companies concerned, the maximum production rate was determined both for the end item and for the major components required for assembly of those items. In general, engines, transmissions and axles, along with certain other components, were evaluated. Along with the maximum production rate, a minimum production rate, based on past experience in contracting for vehicles, was developed. This defines the minimum quantity at which a reasonable production price can be expected from solicitations to industry.

(3) The maximum and minimum production rates are associated with a vehicle family such as the 5-ton truck family rather than with an individual body type within that family. The methodology incorporated in the computer program was such that this real life constraint was imposed on the vehicle family rather than on individual body types, insuring that the study was based on real world production constraints.

(4) In the case of commercial type vehicles, an additional constraint was imposed. Experience with industry has indicated that 2 years is normally the maximum time for which a single design configuration can be procured prior to the introduction of significant model changes. For most quantities, the production was limited to 2 years. For those alternatives requiring a large number of commercial type vehicles, a third year was considered reasonable since the total production volume would be sufficient that industry would maintain that design configuration, even if only for military production.

c. In addition to the maximum and minimum production rates, the cost equations discussed in chapter 5 were utilized to define a cost curve which reflected the economies of scale associated with a particular vehicle family. Since the study is not based on availability of funding in a given year, funding constraints, which would normally have been imposed at this point, were not utilized.

d. The results of this process provided a buy quantity for each vehicle type in the fleet for a given year. At the conclusion of the process, the next year was considered by repeating the entire procedure once again until a 20-year procurement profile was established.

e. The quantitative computation of the procurement program for the 5-ton truck program is summarized in table 4-3. It should be noted that the actual computation required evaluation of each body type to determine shortages, while production constraints and pricing curves had to be evaluated on the basis of total family quantities.

4-6. DEVELOPMENTAL BODY TYPES. Most of the alternatives would not have been feasible unless certain body types could be made available within the remaining payload categories. Based on engineering analysis and judgment, the DARCOM members of the study team defined "dummy vehicles"

Table 4-3. Sample Development of Procurement Program for 5-Ton Truck Family

Funding Delivery Period	81 and prior	82	83	84	85	86	87	88	89	90	91
Starting Assets	*34,820	33,663	32,099	38,549	44,779	50,794	50,794	56,330	58,798	59,838	59,853
Planned Receipts from Procurements	2,020	3,000	8,000	8,000	8,000	8,000	5,307	3,134	3,003	4,460	4,243
Forecast Losses and Sales	3,177	235	225	259	259	259	259	259	259	259	259
Forecast Washouts	0	4,329	1,325	1,511	1,726	2,205	2,580	1,835	2,729	4,216	3,984
Forecast Assets	33,663	32,099	38,549	44,779	50,794	56,330	58,798	59,838	59,838	59,838	59,838
AAO	-	N/A	N/A	N/A	N/A	59,838	59,838	59,838	59,838	59,838	59,838
Shortage	-	N/A	N/A	N/A	N/A	3,508	1,040	0	-15	0	0
Maximum Production Rate	-	3,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Minimum Production Rate	-	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400

N/A - Data not accessible from automated process.

*Actual Assets as of 30 Sep 79

which were included in the appropriate alternative (table 4-4). While no drawings or specifications exist for these vehicles, their technical feasibility could be established on the basis of combining an existing body and an existing chassis with only minor modifications to accommodate the interfaces. Costing (as discussed in chap 5) was also based on these same combinations of existing items. Development cost estimates are included in appendixes P and Q and are incorporated into the overall cost analysis.

Table 4-4. Dummy Vehicles

SSN	Nomenclature	Chassis Source	Alternative
D13197	2 1/2-T Ambulance, Rear Area	M35A1 Cargo Truck (PIP)	3, 8
D13198	2 1/2-T Telephone Maintenance	M35A1 Cargo Truck (PIP)	3, 8
D13199	2 1/2-T Ambulance, Fwd Area	M35A1 Cargo Truck (PIP)	3, 8
D13299	Telephone Maintenance	M876 Telephone Maintenance	6
D14096	5-T Shop Van	M924 Cargo Truck	4, 6, 9
D14097	5-T Water Tanker	M924 Cargo Truck	4, 6, 9
D14098	5-T Fuel Tanker	M924 Cargo Truck	4, 6, 9
D14099	5-T Van, Instrument Repair	M924 Cargo Truck	4, 6, 9
D15997	10-T Tractor Wrecker	M916, Truck Tractor 6x6	5, 7, 8
D15998	10-T Tractor, Fwd Area	M916, Truck Tractor 6x6	5, 7, 8
D15999	10-T Van, Expansible	M916, Truck Tractor 6x6	5, 7, 8
D16299	10-T Dump, Fwd Area	XM977 Truck, Cargo, 8x8 (HEMTT)	5, 7, 8

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D13199	2 1/2-T Ambulance, Fwd Area	M35A1 Cargo Truck (PIP)	3, 8
D13299	Telephone Maintenance	M876 Telephone Maintenance	6
D14096	5-T Shop Van	M924 Cargo Truck	4, 6, 9
D14097	5-T Water Tanker	M924 Cargo Truck	4, 6, 9
D14098	5-T Fuel Tanker	M924 Cargo Truck	4, 6, 9
D14099	5-T Van, Instrument Repair	M924 Cargo Truck	4, 6, 9
D15997	10-T Tractor Wrecker	M916, Truck Tractor 6x6	5, 7, 8
D15998	10-T Tractor, Fwd Area	M916, Truck Tractor 6x6	5, 7, 8
D15999	10-T Van, Expansible	M916, Truck Tractor 6x6	5, 7, 8
D16299	10-T Dump, Fwd Area	XM977 Truck, Cargo, 8x8 (HEMTT)	5, 7, 8

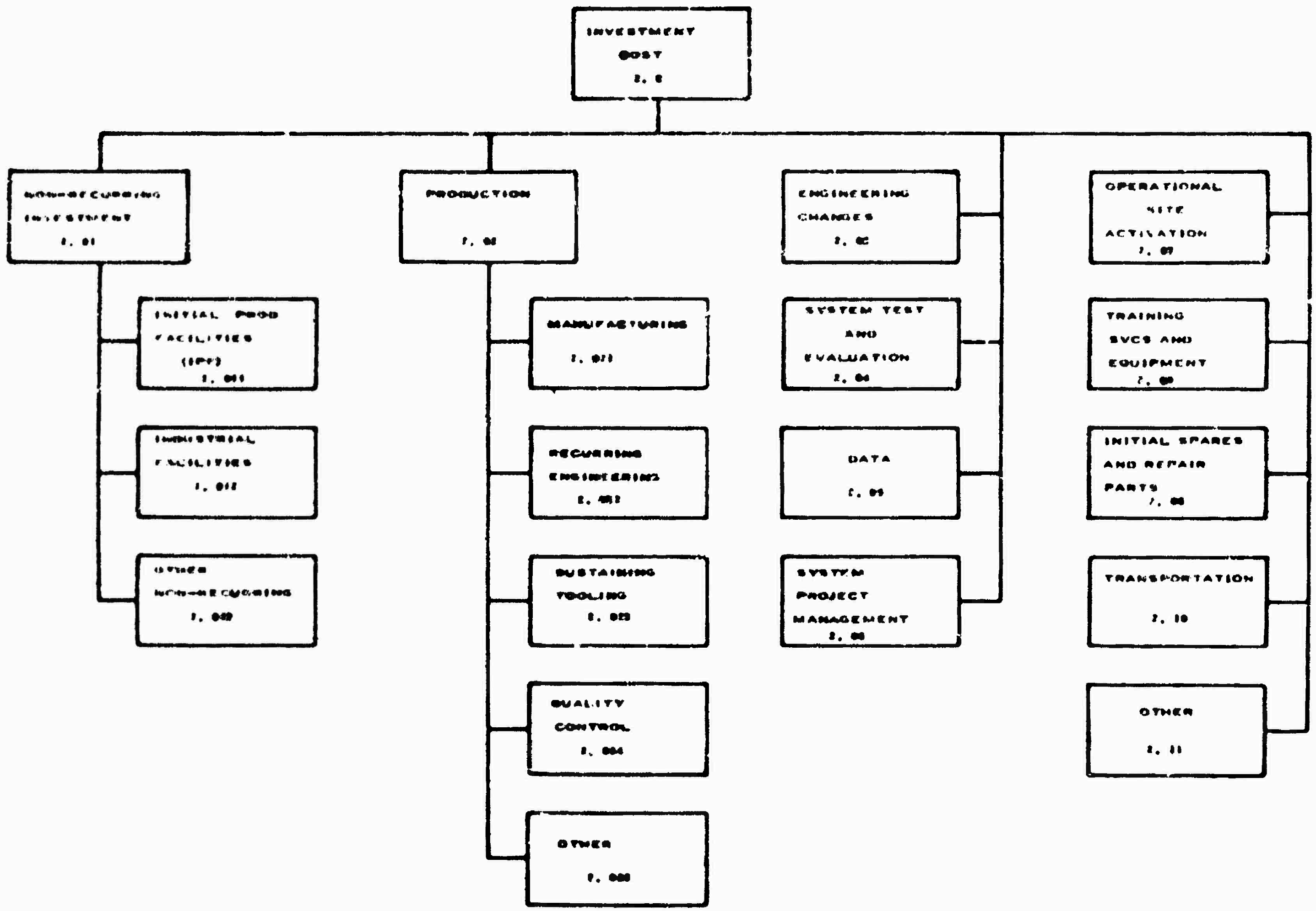

Figure 5-1. Investment cost element structure.

(4) Permanent change of station (PCS).

(5) Replenishment spares.

(6) Petroleum, oils and lubricants (POL).

(7) Modification.

(8) Personnel replacement.

(9) Transients, patients, prisoners.

(10) Quarters, maintenance, utilities.

(11) Medical support.

(12) Integrated Logistics Support (ILS) and repair parts transportation.

b. Distribution of O&S costs were based on the following operational areas:

(1) Active - CONUS, Europe.

(2) Reserves - CONUS.

(3) Prepositioning of Materiel Configured to Unit Sets (POMCUS) - Europe.

(4) Depot - CONUS, Europe.

Distribution factors were extracted from the May 1979 Research, Development and Acquisition Cost (RDAC) worksheets and appear below:

	CONUS (0.77)	EUROPE (0.23)
Active	0.19	0.54
Reserves	0.29	NA
POMCUS	NA	0.36
Depot	0.52	0.10

c. Annual O&S costs per vehicle (SSN) per year were developed in constant FY 82 dollars and reflect a weighted average of all the operational areas defined above. Actual weights used were as shown:

(1) Active (CONUS) = (0.77) (0.19) = 0.146

(2) Active (Europe) = (0.23) (0.54) = 0.124

(3) Reserves = (0.77) (0.29) = 0.223

(4) Depot (CONUS) = (0.77) (0.52) = 0.400

(5) Depot (Europe) = (0.23) (0.10) = 0.023

(6) POMCUS = (0.23) (0.36) = 0.083

d. Development of Cost Factors.

(1) Crew.

Payload Category	Dedicated Drivers/Vehicle
1/4-T	0.28
5/4-T	0.17
2 1/2-T	0.11
5-T	0.58
10-T	0.88
Tractors	1.05
8-T	1.00

The factors above were derived from the proponent input summary sheets and represent the Training and Doctrine Command/Department of the Army (TRADOC/DA) approved Tables of Organization and Equipment (TOE).

(2) Mileage (figures obtained from US Army DARCOM Materiel Readiness Support Activity, 5 Feb 79).

Payload Category	Average Annual Mileage CONUS	Average Annual Mileage Europe
1/4-T	2,700	7,300
5/4-T	3,700	6,400
2 1/2-T	1,800	3,500
5-T	1,900	4,600
8-T	1,100	1,300
10-T	1,700	2,500

(3) Maintenance Personnel.

Payload Category	Maintenance Men per Vehicle		
	CONUS	MACRIT Average	Europe
1/4-T	0.15	0.19	0.353
5/4-T	0.12	0.23	0.311
2 1/2-T, cargo	0.255	0.30	0.447
2 1/2-T, other	0.247	0.29	0.431
5-T, cargo	0.272	0.34	0.579

(4) Indirect Personnel.

Payload Category	Indirect Men/Vehicle			
	CONUS		Europe	
	W/Crew	W/O Crew	W/Crew	W/O Crew
1/4-T	0.098	0.034	0.144	0.080
5/4-T	0.066	0.027	0.109	0.071
2 1/2-T, Cargo	0.083	0.058	0.126	0.101
2 1/2-T, Other	0.081	0.056	0.123	0.098
5-T, Cargo	0.193	0.062	0.263	0.131
5-T, Tractor	0.302	0.063	0.374	0.136
5-T, Other	0.195	0.063	0.268	0.136
8-T	0.306	0.079	0.318	0.091
10-T	0.279	0.079	0.309	0.109
HET	0.329	0.091	0.603	0.126

(a) The number of indirect men per vehicle is a linear function of the number of dedicated drivers and the number of maintenance men per vehicle. In computational form:

No. of Indirect/vehicle = C x (Crew + Maintenance)

(b) The constant C, in the equation above, was developed by the office of the Comptroller of the Army, the office of the Under Secretary of the Army for Operation Research, and the Tactical Wheeled Vehicle Fleet (TWVF) study team at Fort Eustis. The derivation of C is described below.

1 The constant C equals 0.227, the number of indirect men per direct man for a given TOE unit. A sample of 10 TOE units was selected to represent all the Army's current TOE. The selection of these units was based on the units density in the force and its high usage of tactical wheeled vehicles. The following table lists the 10 units and their corresponding data:

SRC	Nomeclature	No. of SRC's in Force	TOE Strength	No. of Indirect
1. 07046H	HHC, Mech Inf Bn	113	172	35
2. 07047H	Mech Inf Co	339	170	9
3. 07048H	CSC Co, Mech Inf	113	154	30
4. 17036H	HHC, Armor Bn	108	179	70
5. 17037H	Tank Co	324	88	8
6. 17039H	CSC Co, Mech Inf	108	97	26
7. 06366H	HHC, 155-How Bn	41	142	53
8. 06367H	FA Bty, 155 Bn	123	107	17
9. 06369H	Svc Bty, 155 Bn	41	67	22
10. 55018H	Med Trk Co	61	181	55

2 The value arrived at for C is a weighted average of the 10 units listed above. The number of indirect men/man for one unit is:

Indirect men/man = (No. of Indirect) ÷ (TOE Strength - No. of Indirect)

NOTE: Calculation of the number of indirect men per man does not include the indirect personnel in the denominator (i.e., the number of indirect personnel is deducted from the total strength in the equation).

3 The result of the above equation (for each TOE) was then weighted by the number of SRC's in the force, summed, and divided by the total number of all 10 SRC's in the force. In summary,

$$C = \sum_{SRC=1}^{10} \frac{(\text{No. of SRC's})\ (\text{Indirect men/man})}{\text{Total number of SRC's}} = 0.227$$

(5) Other Cost Factors.

(a) Variables such as base pay, theater allowances, rotation rates, and attrition rates were extracted from the October 1979 Army Force Planning Cost Handbook (AFPCH). Historical escalation factors were obtained from a February 1980 report, "TARADCOM/TARCOM Inflation/Price Escalation Instructions."

(b) Replenishment spares for trucks were costed as a linear function of operating mileage. The basic spares costs for trucks, trailers, and semitrailers were derived from a recent repair parts study, "Repair Parts Cost Factors for Tactical Vehicles," DRSTA - ECC Report No. 06-80-02, July 1980, which involved analysis of support listings.

e. Table 5-1 is a list of SSN's and their O&S costs by operational area. The "N" in parenthesis beside some of the SSN's indicates a new/developmental item. The O&S cost for those vehicles in the Reserve units was calculated as 25 percent of the CONUS active-without-driver figure (Source: ODCSPER). The O&S costs for those vehicles in POMCUS were calculated using the European maintenance man-hour values provided by the Combat Equipment Group Europe (CEGE). CONUS depot figures were obtained from Depot System Command (DESCOM). Europe depot figures were derived by multiplying the CONUS depot figures by the ratio of an E3's base pay in Europe to an E3's base pay in CONUS (i.e., Europe depot = 1.2 CONUS depot). The weighted average O&S costs in the last column are the values that were input into the MARS model.

f. The O&S costs for the military design 1/4-ton trucks are higher than for the commercial design 1 1/4-ton trucks because of increased maintenance personnel and replenishment spare requirements. Within the 1 1/4-ton category, high mobility vehicles such as the GAMA GOAT (D11201

Table 5-1. Annual Operating and Support Cost Per SSN by Operational Area (Constant FY 82 Dollars)

SSN	ACTIVE	W/O CREW	ACTIVE	W/CREW	RESERVES	POMCUS	DEPOT		W/O CREW WEIGHTED AVERAGE
	CONUS	EUROPE	CONUS	EUROPE			CONUS	EUROPE	
1/4T									
D15101	4,006	10,942	9,074	16,901	1,002	1,344	604	719	2,538
D15101(N)	3,947	10,774	9,015	16,733	987	1,333	604	719	2,505
D15102	4,070	11,159	9,138	17,118	1,018	1,364	604	719	2,580
D15102(N)	3,986	10,933	9,054	16,483	997	1,300	604	719	2,530
D15402	4,070	11,159	9,138	17,118	1,018	1,364	604	719	2,580
D18400	3,953	10,725	9,021	16,684	988	1,344	604	719	2,501
5/4T									
D11101	3,692	9,538	6,773	14,313	923	1,015	604	719	2,273
D11101(N)	3,292	8,828	6,373	13,603	823	965	604	719	2,100
D11103	3,708	9,593	6,789	14,368	927	1,002	604	719	2,282
D11103(N)	3,298	8,873	6,379	13,648	825	942	604	719	2,105
D11106	3,791	9,752	6,872	14,527	948	1,014	604	719	2,320
D11106(N)	3,356	8,970	6,437	13,745	839	970	604	719	2,131
D11201	4,477	11,102	7,558	15,877	1,119	1,187	604	719	2,640
D11202	4,486	11,111	7,567	15,886	1,122	1,196	604	719	2,644
D15104	3,291	8,866	6,372	13,641	823	935	604	719	2,102
D15301	4,098	10,439	7,179	15,214	1,025	1,129	604	719	2,477
D15302	4,126	10,467	7,207	15,242	1,032	1,157	604	719	2,488
D15303	4,098	10,439	7,179	15,214	1,025	1,129	604	719	2,477
D15401	4,408	10,958	7,489	15,733	1,102	1,202	604	719	2,610
2 1/2T									
D13101	7,659	15,673	9,648	18,045	1,915	2,490	741	889	4,018
D13101(N)	7,747	15,711	9,736	18,083	1,937	2,617	741	889	4,051
D13103	7,679	15,684	9,667	18,046	1,920	1,693	741	889	3,957
D13103(N)	7,547	15,417	9,535	17,779	1,887	1,668	741	889	3,895

Table 5-1. (cont) Annual Operating and Support Cost per SSN by Operational Area (Constant FY 82 Dollars)

SSN	W/O CREW ACTIVE CONUS	W/O CREW EUROPE	W/CREW ACTIVE CONUS	W/CREW EUROPE	RESERVES	POMCUS	DEPOT CONUS	DEPOT EUROPE	W/O CREW WEIGHTED AVERAGE
2 1/2T (cont)									
D13104	7,477	15,266	9,465	17,628	1,869	1,656	741	889	3,861
D13104(N)	7,431	15,175	9,419	17,537	1,858	1,648	741	889	3,840
D13105	7,848	16,054	9,837	18,426	1,962	2,572	741	889	4,110
D13105(N)	7,613	15,523	9,602	17,895	1,903	2,498	741	889	3,991
D13106	8,495	17,281	10,484	19,653	2,124	2,914	741	889	4,422
D13107	8,551	17,006	10,540	19,378	2,138	3,195	741	889	4,422
D13108	8,803	17,589	10,792	19,961	2,201	3,222	741	889	4,548
D13109	8,321	17,060	10,310	19,432	2,080	2,764	741	889	4,347
D13109(N)	8,265	16,944	10,254	19,316	2,066	2,754	741	889	4,320
D13110	8,183	16,756	10,172	19,128	2,046	2,708	741	889	4,276
D13110(N)	8,128	16,641	10,117	19,013	2,032	2,699	741	889	4,250
D13111	7,845	16,087	9,834	18,459	1,961	2,552	741	889	4,112
D13111(N)	7,748	12,479	9,737	18,314	1,937	2,492	741	889	3,639
D13112	8,094	16,502	10,083	18,874	2,024	2,701	741	889	4,226
D13112(N)	8,021	16,345	10,010	18,717	2,005	2,686	741	889	4,181
D13200	8,577	17,198	10,566	19,570	2,144	3,037	741	889	4,438
5T									
D14001	9,299	23,314	19,790	35,828	2,325	3,710	977	1,172	5,501
D14002	8,818	21,912	19,292	34,425	2,205	3,447	977	1,172	5,207
D14002(N)	8,935	22,164	19,409	36,677	2,234	3,400	977	1,172	5,258
D14003	8,813	21,871	19,287	36,384	2,203	3,503	977	1,172	5,206
D14003(N)	8,927	22,120	19,401	36,633	2,232	3,453	977	1,172	5,256
D14004	9,326	23,342	19,817	35,856	2,332	3,701	977	1,172	5,509
D14004(N)	9,285	23,221	19,776	35,735	2,321	3,697	977	1,172	5,485
D14005	9,024	22,539	19,515	35.053	2,256	3,587	977	1,172	5,338
D14006	9,167	22,876	28,161	45.563	2,292	3,821	1,116	1,339	5,488

Table 5-1. (cont) Annual Operating and Support Cost Per SSN by Operational Area (Constant FY 82 Dollars)

SSN	ACTIVE CONUS	W/O CREW EUROPE	ACTIVE CONUS	W/CREW EUROPE	RESERVES	POMCUS	DEPOT CONUS	DEPOT EUROPE	W/O CREW WEIGHTED AVERAGE
5T (cont)									
D14006(N)	9,104	22,697	28,098	45,834	2,276	3,805	1,116	1,339	5,452
D14007	9,298	23,078	28,292	46,215	2,325	3,932	1,116	1,339	5,549
D14007(N)	9,430	23,130	28,424	46,267	2,358	3,932	1,116	1,339	5,595
D14008	9,590	23,713	20,081	36,227	2,398	3,933	977	1,172	5,627
D14008(N)	9,539	23,582	20,030	36,096	2,385	3,919	977	1,172	5,599
D14009	10,097	25,220	20,588	37,734	2,524	4,138	977	1,172	5,934
D14009(N)	10,058	25,101	20,549	37,615	2,515	4,136	977	1,172	5,911
D14010	9,696	24,210	20,170	38,723	2,424	3,872	977	1,172	5,705
D15900	9,663	22,872	28,157	46,009	2,291	3,817	1,116	1,339	5,486
D15900(N)	8,895	22,208	27,889	43,345	2,224	3,732	1,116	1,339	5,343
D16000	9,201	22,946	28,195	46,083	2,300	3,846	1,116	1,339	5,506
D17201	9,544	23,561	20,018	38,074	2,386	3,890	977	1,172	5,595
D17202	9,855	24,486	28,849	47,623	2,464	4,278	1,116	1,339	5,865
D17203	9,896	24,473	20,387	36,987	2,474	4,119	977	1,172	5,799
8T									
D16102	12,942	17,135	31,022	38,697	3,236	3,663	1,116	1,339	5,525
D16103	15,498	20,646	33,578	42,208	3,875	4,288	1,116	1,339	6,529
D16104	13,178	17,394	31,258	38,956	3,295	3,783	1,116	1,339	5,614
10T									
D10101	13,029	20,521	32,007	43,153	3,257	3,668	1,116	1,339	5,963
D10102	16,691	26,489	41,009	59,573	4,173	4,749	1,116	1,339	7,534
D16101	16,005	26,763	34,743	48,323	4,001	4,502	1,116	1,339	7,408
D16201	12,722	20,068	28,637	39,047	3,181	3,428	1,116	1,339	5,825
D16202	14,814	23,674	30,729	42,653	3,704	4,028	1,116	1,339	6,745

Table 5-1. (cont) Annual Operating and Support Cost Per SSN by Operational Area (Constant FY 82 Dollars)

SSN	ACTIVE CONUS	W/O CREW EUROPE	ACTIVE CONUS	W/CREW EUROPE	RESERVES	POMCUS	DEPOT CONUS	DEPOT EUROPE	W/O CREW WEIGHTED AVERAGE
10T (cont)									
D16203	13,205	20,831	29,120	39,810	3,301	3,635	1,116	1,339	6,035
D16204	12,870	20,259	28,785	39,238	3,218	3,504	1,116	1,339	5,885
D16205	12,653	19,914	31,631	42,546	3,163	5,227	1,116	1,339	5,941
D19601	11,659	18,428	30,637	41,060	2,915	3,110	1,116	1,339	5,380
D19602	11,699	18,491	30,677	41,123	2,925	3,139	1,116	1,339	5,399
D19604	12,794	20,152	31,772	42,784	3,199	3,543	1,116	1,339	5,860
Trailers									
D05800	2,223	2,688			578	323	253	304	918
D06200	2,280	2,736			674	328	253	304	936
D05000	2,354	2,737			611	328	253	304	951
D06400	2,322	2,806			603	337	253	304	954
D06800	2,275	2,750			591	330	253	304	937
D00200	1,896	2,205			474	265	253	204	787
D01100	2,920	3,403			730	408	253	304	1,155
D04600	1,896	2,205			474	265	253	304	787
D07200	3,097	3,609			774	433	253	304	1,218
D00800	1,937	2,254			484	270	253	304	802
D05400	2,913	3,390			728	407	253	304	1,152
D06600	3,509	4,099			877	492	253	304	1,367
D00100	3,090	3,605			773	433	253	304	1,216
D01201	3,017	3,518			754	422	376	451	1,243
D00300	3,009	3,509			752	421	376	451	1,240
D07000	2,957	3,442			739	413	376	451	1,220
D05200	3,006	3,501			752	420	376	451	1,238
D05700	3,006	3,501			752	420	376	451	1,238

Table 5-1. (cont) Annual Operating and Support Cost Per SSN by Operational Area (Constant FY 82 Dollars)

SSN	ACTIVE CONUS	W/O CREW EUROPE	ACTIVE CONUS	W/CREW EUROPE	RESERVES	POMCUS	DEPOT CONUS	DEPOT EUROPE	W/O CREW WEIGHTED AVERAGE
Semitrailers									
D03000	3,533	4,127			883	495	376	451	1,429
D03200	3,146	3,667			787	440	376	451	1,289
D03600	3,136	3,655			784	439	376	451	1,285
D04000	3,644	4,259			911	511	376	451	1,469
D04400	3,588	4,193			897	503	376	451	1,449
D01000	3,115	3,630			779	436	376	451	1,277
D01502	3,319	3,873			830	465	376	451	1,351
D02302	3,422	3,995			856	479	376	451	1,388
D02302(N)	3,422	3,995			856	479	376	451	1,388
D02303	3,160	3,684			790	442	376	451	1,294
D02303(N)	3,160	3,684			790	442	376	451	1,294
D02307	3,422	3,995			856	479	376	451	1,388
D02500	3,422	3,995			856	479	376	451	1,388
D03400	3,187	3,716			797	446	376	451	1,304
D04800	3,192	3,722			798	447	376	451	1,305
D01501	3,347	3,906			837	469	400	480	1,372
D00600	3,347	3,906			837	469	400	480	1,372
D01600	3,864	4,511			966	541	400	480	1,557
D00700	3,978	4,647			995	558	400	480	1,599
D02400	4,215	4,929			1,054	591	400	480	1,684
D01400	3,521	4,113			880	494	400	480	1,424
Dummy Vehicles									
D13197	7,506	15,165	9,495	17,537	1,877	2,514	741	889	3,926
D13198	7,524	15,254	9,513	17,626	1,881	2,496	741	889	3,939
D13199	7,326	14,749	9,315	17,121	1,832	2,452	741	889	3,833
D13299	8,577	17,198	10,566	19,570	2,144	3,037	741	889	4,438

Table 5-1. (cont) Annual Operating and Support Cost Per SSN by Operational Area (Constant FY 82 Dollars)

SSN	ACTIVE W/O CREW CONUS	ACTIVE W/O CREW EUROPE	ACTIVE W/CREW CONUS	ACTIVE W/CREW EUROPE	RESERVES	POMCUS	DEPOT CONUS	DEPOT EUROPE	W/O CREW WEIGHTED AVERAGE
Dummy Vehicles (cont)									
D14096	9,943	24,772	20,434	37,286	2,486	4,086	977	1,172	5,843
D14097	10,092	25,313	20,583	37,827	2,523	4,116	977	1,172	5,942
D14098	10,262	25,769	20,753	38,283	2,566	4,200	977	1,172	6,040
D14099	9,726	24,055	20,217	36,569	2,432	4,020	977	1,172	5,704
D15997	9,370	22,826	28,364	45,513	2,343	4,151	1,116	1,339	5,550
D15998	11,659	18,428	30,637	41,060	2,915	3,110	1,116	1,339	5,380
D15999	9,478	23,277	19,969	35,791	2,370	3,971	977	1,172	5,553
D16299	14,456	22,789	38,774	55,873	3,614	4,254	1,116	1,339	6,582

and D11202) and the High Mobility Multipurpose Wheeled Vehicles (HMMWV) (D15301, 2, 3, and D15401) also have significantly higher replenishment spares costs. The variations in cost among the 2 1/2-ton trucks predominantly reflect differences in replenishment spares costs based on special equipment of the various vehicle types. For instance, tank trucks (D13109 and D13110) have pumps, valves, and dispensing equipment which boost the spares cost. The maintenance trucks (D13106, 7, 8 and D13200) have a variety of special items such as winches, earth-boring devices, and pole derricks depending on the particular model. The costs of 5-ton trucks are also differentiated by the replenishment spares cost of accessories and special equipment including cranes, expansion bodies, and winches. In the 10-ton category, two SSN's show total O&S costs which are several thousand dollars above the others. D10102 includes vehicles which range from 10 to 25 tons. The SSN was costed as a weighted average of three vehicles - a 10-ton, a 22 1/2-ton, and a 25-ton tractor. The 22 1/2-ton tractor (M746) which constitutes about 60 percent of the total, is a military design with high unit repair parts costs. These larger vehicles also get fewer miles to the gallon as well as having higher maintenance requirements. All these factors contribute to the higher total O&S cost. D16101 is the 10-ton GOER wrecker. The increased total cost of it is attributable to the high replenishment spares cost.

g. Crew Costs.

(1) The weighted average crew pay and allowances per vehicle is $9,878 per year. The derivation of this figure is described below:

	CONUS	Europe	
E3:	$13,321	$16,160	
E4:	$14,683	$17,522	(Source: TARCOM)

(2) The average grade of a driver was determined to be between E3 and E4, using those units analyzed in the determination of the number of indirect men (d(4) above). The grade distribution is equivalent to 60-percent E3 and 40-percent E4.

CONUS-ACTIVE : ($13,321 x 0.6) + ($14,683 x 0.4) = $13,866

RESERVES : $13,866 x 0.25 = $3,466

EUROPE-ACTIVE: ($16,160 x 0.6) + ($17,522 x 0.4) = $16,705

(3) Using the distribution from 7-4b, the three values were weighted:

($13,866 x 0.77 x 0.19) + ($3,466 x 0.77 x 0.29) + ($16,705 x 0.23 x 0.54) = $2,029 + $774 + $2,075 = $4,878

(0.77 x 0.19) + (0.77 x 0.29) + (0.23 x 0.54) = 0.4938

Average crew pay and allowances = $4,878 ÷ 0.4938 = $9,878

h. Maintenance Personnel.

(1) The number of maintenance men per vehicle used in this study is listed by payload category in the following table:

Payload Category	Maintenance Men Per Vehicle					
	Active CONUS	Active EUR	Reserves	Depot CONUS	Depot EUR	POMCUS
1/4-T	0.150	0.353	0.038	0.014	0.014	0.018
5/4-T	0.120	0.311	0.030	0.014	0.014	0.025
2 1/2-T, cargo	0.255	0.447	0.064	0.017	0.017	0.046
2 1/2-T, other	0.247	0.431	0.062	0.017	0.017	0.046
5-T, cargo	0.272	0.579	0.068	0.023	0.023	0.050
5-T, tractor	0.279	0.598	0.070	0.026	0.026	0.057
5-T, other	0.278	0.599	0.070	0.023	0.023	0.050
8-T	0.349	0.400	0.087	0.026	0.026	0.057
10-T	0.347	0.480	0.087	0.026	0.026	0.057
HET	0.401	0.557	0.100	0.026	0.026	0.057

Derivation of the number of maintenance men per vehicle for CONUS and EUROPE, in the above table, is discussed below.

(2) According to DA Pamphlet 11-4, "Operating and Support Costs Guide for Army Materiel Systems," replenishment spares should be calculated as a linear function of operating mileage. This implies that the requirement for spare parts increases with an increase in vehicle use, just as fuel consumption increases when a vehicle is driven more miles. The derivation of maintenance men per vehicle for CONUS and Europe used in this study was based upon the same logic prescribed for replenishment spares in DA Pam 11-4. That is, the number of maintenance man-hours required by a vehicle should be linearly related to the operating mileage of the vehicle. The starting point for computing the function needed to predict maintenance men per vehicle as a function of operating mileage was the Manpower Authorization Criteria (MACRIT) data displayed in AR 570-2, Organization and Equipment Authorization Tables: Personnel.

(3) AR 570-2 gives the number of maintenance man-hours (mmh) required by type vehicle in terms of three levels of maintenance--organizational, direct support (DS), and general support (GS). The number of maintenance men per vehicle required is calculated as follows:

Maintenance men/vehicle = (organizational + DS + GS) ÷ available productive time

Available productive time per man per year used was 1,590 hours and was taken from the TARCOM O&S cost factors manual, dated 26 February 1980.

Using the 1/4-ton truck as an example, the number of maintenance men per vehicle equals:

Organizational + DS + GS
(194 mmh + 70 mmh + 37 mmh) ÷ 1,590 hours = 0.19

The operating mileage associated with 0.19 maintenance men per 1/4-ton truck was a worldwide average of 3,600 miles (Source: US Army DARCOM Materiel Readiness Support Activity, 5 Feb 79).

The linear relationship at this point, between maintenance men per vehicle and operating mileage, looks like this:

$$0.19 = 3{,}600\ M + B,$$

where B is the fixed component of the expression and M is the slope of the straight line. In order to derive the general equation,

$$Y = Mx + B$$

where Y = maintenance men/vehicle
x = operating mileage

The values of M and B must be calculated.

(4) B was calculated as follows:

(a) That portion of organizational maintenance, which is termed scheduled maintenance, is performed regardless of the operating mileage of the vehicle. It is fixed and accounts for 25 percent of the organizational maintenance man-hour figure given in AR 570-2 (Source: TARCOM Cost Analysis Division). For the case of the 1/4-ton truck, scheduled maintenance was calculated as follows:

Scheduled maintenance = 0.25 x 194 = 48.5 mmh

(b) In order to determine the fixed component, B, in the generalized equation, Y = Mx + B, the following relationship must be solved:

$$\frac{\text{Scheduled mmh}}{\text{Total mmh}} = \frac{B}{\text{Maintenance men/vehicle}}$$

where, scheduled mmh = 48.5
Total mmh = organizational + DS + GS = 194 + 70 + 37 = 301

maintenance men/vehicle = 0.19

therefore, $B = (48.5 \times 0.19) \div 301$
$= 0.031$

The generalized formula: $Y = Mx + 0.031$

M is solved for as follows:

$$M = (Y - 0.031) \div x$$

$Y = 0.19$

$x = 3600$

$$M = (0.19 - 0.031) \div 3600$$
$$= .0000441$$

thus,

$$Y = .0000441x + 0.31$$

is the formula used for the 1/4-ton truck to calculate the number of maintenance men per vehicle (Y) as a function of operating mileage (x).

Using the average annual operating mileage figures for CONUS and EUROPE (d(2) above), the number of maintenance men per vehicle in CONUS and EUROPE is calculated as follows:

CONUS: $Y = (.0000441 \times 2{,}700) + 0.031$
$= 0.150$

EUROPE: $Y = (.0000441 \times 7{,}300) + 0.031$
$= 0.353$

The same methodology was used to derive the number of maintenance men per vehicle in CONUS and EUROPE for all other payload categories.

(5) The number of maintenance men per vehicle in Reserve units was calculated as 25 percent of the number derived for those units in active CONUS. Rationale: Reserve units work 25 percent of the time active units in CONUS work.

(6) The number of maintenance men per vehicle for those vehicles in depot (CONUS and Europe) was acquired from Depot System Command (DESCOM).

(7) The number of maintenance men per vehicle for those vehicles in POMCUS (Europe) was acquired from the Combat Equipment Group Europe (CEGE).

5-4. 20-YEAR PROGRAM COSTS. Table 5-2 is a display of the total cost to buy and maintain each alternative fleet, plus drivers, for 20 years. Rank-ordered, from least costly to most costly, the alternatives appear as follows:

			Discounted FY 82 $ Billions
(Least Costly)	1	Alt 2 (-, 5/4, 2 1/2, 5, 10)	$32.74B
	2	1 (1/4, 5/4, 2 1/2, 5, 10) Base	33.07B
	3	3 (1/4, -, 2 1/2, 5, 10)	33.82B
	4	9 (-, 5/4, -, 5, 10)	35.72B
	5	7 (-, 5/4, 2 1/2, -, 10)	35.86B
	6	4 (1/4, 5/4, -, 5, 10)	35.98B
	7	5 (1/4, 5/4, 2 1/2, -, 10)	36.17B
	8	6 (1/4, -, -, 5, 10)	36.37B
(Most Costly)	9	8 (1/4, -, 2 1/2, -, 10)	36.83B

5-5. MANPOWER COMPARISON.

a. Figure 5-2 depicts the percent deviation of each alternative from the base case in terms of mechanics, drivers, indirect and total personnel.

b. The largest net change in the number of drivers of any one alternative over (or under) the base case never exceeded 1 percent. In effect, the number of drivers required by an alternative has no significant effect on total manpower requirements and, therefore, has no impact on distinguishing an alternative in accordance with our criterion. The appearance of a 1 percent decrease in alternatives 5, 6, and 8 indicates those few instances where two vehicles of one payload class (e.g., 5-ton) could be replaced by a larger payload class (e.g., 10-ton) thereby saving one driver. The computation of maintenance men per vehicle used to derive the percent deviation of each alternative, when compared to the base case, included consideration of the shift in mileage base for weight class substitution. For example, when a 2 1/2-ton vehicle was replaced by a 5-ton and a 5/4-ton, the mileage which would have been driven utilizing the 2 1/2-ton was the basis for computation of the maintenance men per vehicle for the other two weight classes.

c. Alternative 2 clearly requires fewer mechanics than all other alternatives (7% fewer mechanics than the base case) because all 1/4-ton requirements went to the 5/4-ton vehicles, and as indicated in 5-3d(3) above, the 5/4-ton class requires fewer mechanics than the 1/4-ton class, with its associated trailers. The number of mechanics in alternatives 7 and 9 fall below the base case because they both include elimination of the 1/4-ton payload class. All other alternatives require more mechanics than the base case because the substitute vehicle in each case requires more mechanics than the vehicle it is replacing.

Table 5-2. Total 20-Year Program Costs for Each Alternative Fleet (Constant FY 82 Dollars, Discounted, Billions)

Number	Alternative 1/4	5/4	2 1/2	5	10	Procurement + Development	Operating & Support (- Driver)	Driver	Total	Total Discounted
1	X	X	X	X	X	26.78	30.19	13.07	70.04	33.07
2	0	X	X	X	X	27.00	28.96	13.06	69.02	32.74
3	X	0	X	X	X	27.09	31.12	13.01	71.22	33.82
4	X	X	0	X	X	27.85	32.68	13.12	73.65	35.98
5	X	X	X	0	X	32.56	30.63	13.01	76.20	36.17
6	X	0	0	X	X	28.01	34.25	12.88	75.14	36.37
7	0	X	X	0	X	32.76	29.42	13.01	75.19	35.86
8	X	0	X	0	X	32.98	31.55	12.95	77.48	36.33
9	0	X	0	X	X	28.06	31.40	13.03	72.49	35.72

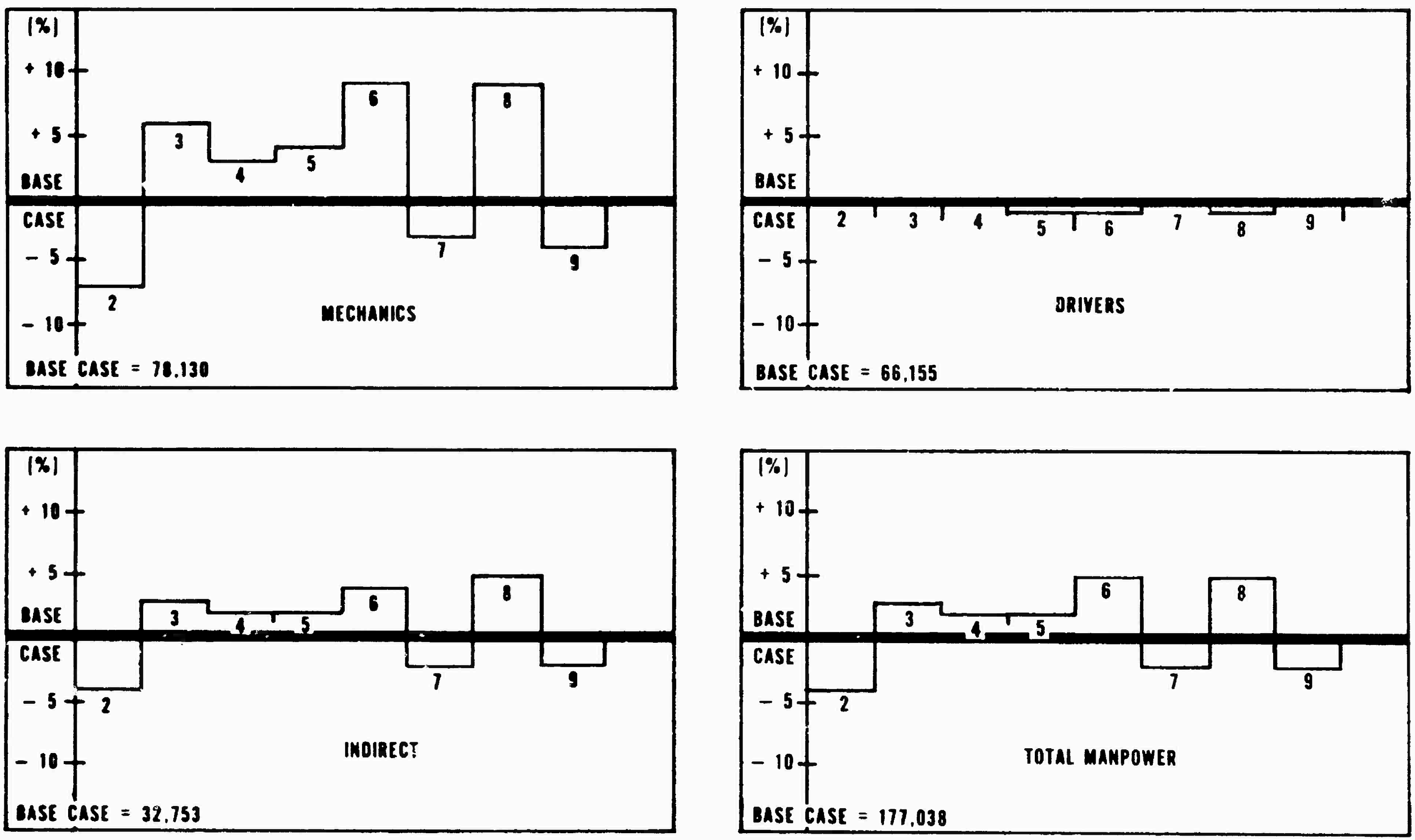

Figure 5-2. Comparison of manpower requirements for mechanics, drivers, and indirect personnel.

d. The number of indirect personnel is a linear function of the number of mechanics and drivers. Its graph is a close approximation of the graph of mechanics because of the neglible impact drivers have on the linear function.

e. The relationship between total manpower and cost is explained in the next section.

5-6. COST COMPARISON.

a. Figure 5-3 demonstrates graphically the percent deviation of each alternative from the base case in terms of O&S costs, production and development (P&D) costs, total, and discounted dollar costs.

b. The O&S cost graph closely approximates the total manpower graph of figure 5-2 because most of the O&S cost (approximately 60-80%) is personnel related. In addition, since drivers show very little influence in manpower deviations from the base case, the number of mechanics is the primary influence of the O&S cost graph.

c. The P&D cost graph indicates that the elimination of one or more payload categories never results in a savings of P&D money. Alternatives 5, 7, and 8 resulted in an increase of greater than 20 percent (over the base case) because each of the alternatives required the purchasing on a 1 for 1 basis of the more expensive 10-ton vehicles.

d. Total costs, in constant FY 82 dollars, represent a combination of the O&S and P&D graphs; for example, low O&S (2% less than base case for alternative 7) coupled with high P&D (22% greater for alternative 7) resulted in a 7 percent increase over the base case for alternative 7. Similarly, since the percent decrease in O&S for alternative 2 exceeded the percent increase in P&D, the total 20-year cost for alternative 2 was found to be 1 percent less than the base case.

e. The graph of discounted dollars indicates that discounting has an insignificant effect on the relative position of each alternative with respect to the base case.

5-7. TIME COMPARISON. The time to fill the AAO is primarily dependent upon developmental leadtime, maximum production rate, and the age of current assets. The differences between alternatives did not exceed one year and could be adjusted in that range, in the judgement of acquisition planners, with minimum cost impact. For this reason, time to AAO is not considered to be a discriminator between alternatives.

5-8. SUMMARY.

a. Figures 5-2 and 5-3 summarize the impact of cost and manpower resources on the criterion of discerning the least costly alternative. Alternative 2 already stands out as the alternative requiring fewer people (mechanics, predominantly), and exhibit the least cost of all

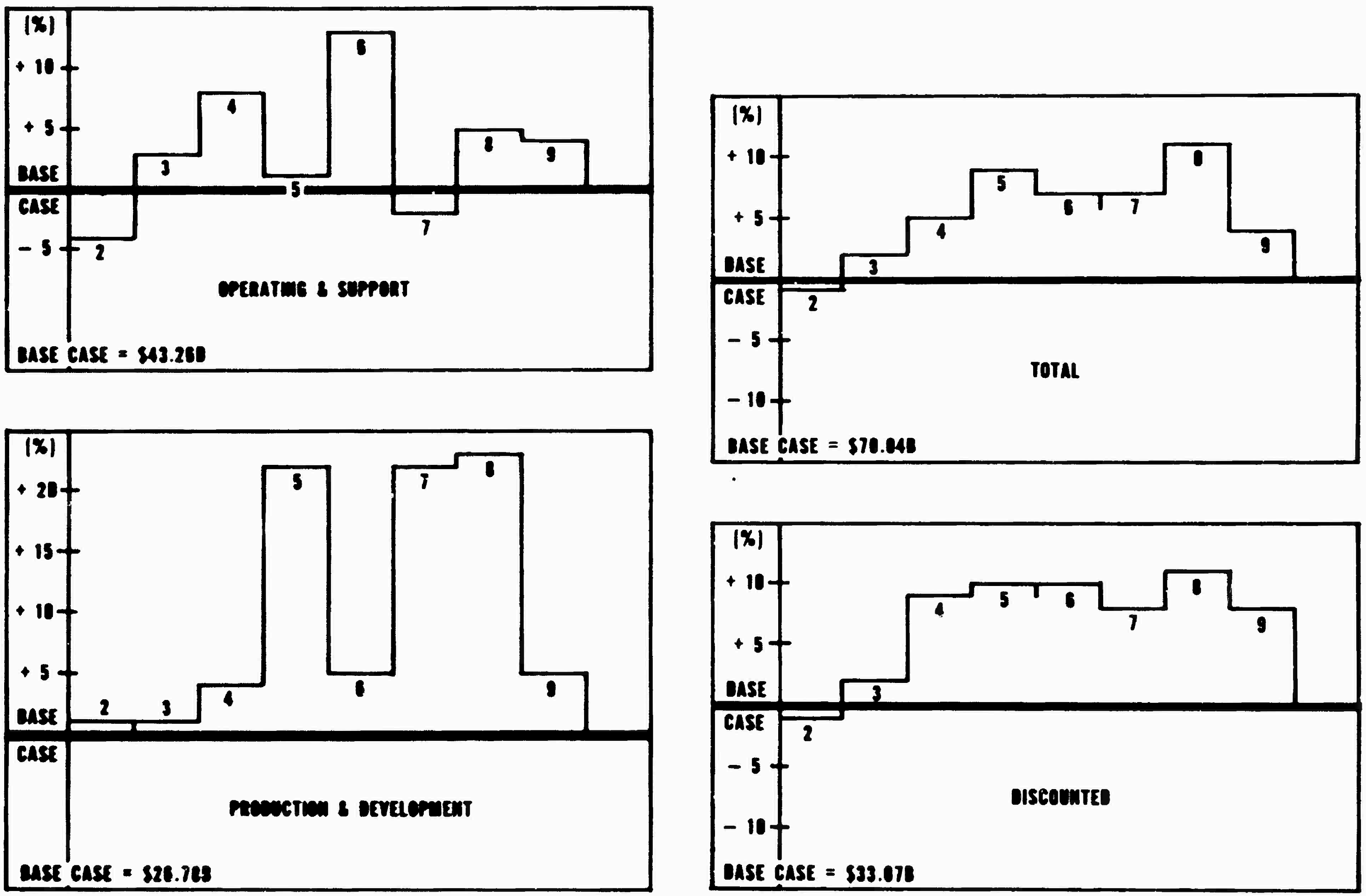

Figure 5-3. Cost comparison of base case and all alternatives.

alternatives over a period of 20 years. Alternative 2 is the only alternative which is less costly than the base case.

b. Alternatives 4, 5, 6, and 8, because they are costly in manpower and are more expensive than the base case, should be ranked last.

c. Because of manpower requirements, alternative 3 is the next least desirable alternative.

d. Comparison of alternatives 1, 7, and 9 shows that 7 and 9 are more expensive than the base case but save manpower over the base case with 7 being the most expensive and saving the least manpower. These alternatives are ranked behind the base case with 7 ranked behind 9, due to dollar costs and manpower.

CHAPTER 6

ANALYSIS OF FLEET MIX ALTERNATIVES

6-1. INTRODUCTION. In this chapter, fleet mix alternatives are analyzed according to mission needs and nonquantifiable factors.

6-2. STANDARD FOR COMPARISON. The base case (alternative 1) was selected as the standard for comparison. This alternative represents the Army's currently planned fleet consisting of 1/4-, 5/4-, 2 1/2-, 5 -, 10-ton trucks, tractors, and trailers. Each alternative, expanded to full Authorized Acquisition Objective (AAO), is compared to the base case at full AAO to determine whether it improves or degrades fleet performance.

6-3. TABLE OF ORGANIZATION AND EQUIPMENT/BASIS OF ISSUE PLAN (TOE/BOIP) ADJUSTMENTS.

a. By design, the base case tactical wheeled vehicle requirement is based on TOE effective in 1986 and includes the impact of current Training and Doctrine Command (TRADOC) approved BOIP. The choice of 1986 as a focus for requirements allows comparison of alternative acquisition plans and, as a result, program costs of each alternative. The 8-ton GOER does not appear as a requirement in the base case since it is replaced by 5- and 10-ton vehicles in the 10-ton HEMTT BOIP. Additionally, the base case replaces the 1/2-ton MULE with 1/4- and 5/4-ton vehicles and includes a new 5/4-ton commercial utility/cargo vehicle (CUCV) and HMMWV replacement for the M561 and M792 GAMA GOAT and 5/4-ton commercial type vehicles (M880) currently in the inventory.

b. Operationally, the base case fleet may be considered to be a satisfactory set of tactical wheeled vehicles capable of meeting the Army's needs in 1986. During analysis of tasks requiring vehicles, a conscious effort was made by TOE proponents to hold the capability of the base case equal to that specified in TOE and BOIP documents while applying changes to 1/2-ton MULE and 5/4-ton GAMA GOAT vehicles. There are, in fact, shortages of tactical wheeled vehicles and overload conditions in certain TOE that should be corrected. By agreement, these TOE were not changed for purposes of study consideration, even though corrections are being processed by TRADOC through the normal TOE change process. In the development of alternative fleets, TOE proponent agencies were directed to use the same set of tasks requiring vehicles and to hold fleet capabilities constant across the alternatives in order to develop equally effective alternative fleets for the study.

c. From a nonresource point of view, the numbers and types of tactical wheeled vehicles needed in each fleet mix alternative impact on the structure of TOE other than its vehicle needs, on the proficiency and productiveness of drivers and mechanics, and on the combat effectiveness of brigades, divisions and higher echelons. In general, fewer numbers and types should mean better command, control, and management in TOE units, more proficient and productive drivers and mechanics, better management, and less redundancy of tactical wheeled vehicle assets at higher echelons. For these reasons, the extent to which the numbers and types of vehicles could be reduced in fleet mix alternatives was compared.

d. Table 6-1 displays the manner in which TOE proponents replaced base case vehicles when forced to find replacements from the fleet mix under consideration. For example, in alternative 2, when the 1/4-ton was removed from the fleet, 26 percent of the jeeps and trailers were replaced by the M880 commercial pickup (or its CUCV replacement) and 74 percent of the jeeps were considered to require HMMWV replacement because of mobility considerations.

e. The TOE analysis by proponents resulted in vehicle replacement ratios that came close to 1:1 between the alternative mixes. Payload independence of tasks, battlefield flexibility, payload volume and general support transportation unit capability are the primary reason for the 1:1 substitution ratio.

(1) Payload independence of tasks. Only 11 percent of the 2 1/2-ton vehicles are for vans, dumps, and special body types. The remainder are for the cargo versions. Figure 6-1 shows that 93.5 percent of the tasks performed by the 2 1/2-ton vehicles are related to unit mobility and other payload independent tasks such as van and shelter transport, prime mover, dedicated bed and tractor tasks. Unit mobility includes such tasks as mess maintenance and supply section equipment and personnel transport. These tasks take as many 5-ton trucks to perform as they do 2 1/2-ton trucks.

(2) Flexibility. The 2 1/2-ton trucks performing payload dependent tasks require 5-ton substitution on a 1-for-1 basis because of the need to service multiple subelements simultaneously.

(3) Payload volume. The bed size of the 2 1/2-ton and 5-ton trucks are identical; therefore, they can have the same number of personnel and the same cube loads. Few 2 1/2-ton vehicles haul ammunition. Most types of ammunition "weighs out" far sooner than it "cubes out."

(4) General support transportation unit. General support transportation unit capability and number of vehicles is a function of support requirements and command and control capability. Prior to this study, most of the TOE for transportation companies, which formerly had the 2 1/2-ton truck, were changed at a 1:1 ratio to 5-ton trucks to solve the force structure problems documented at the Administrative Logistics Systems Program Review conducted in February 1980.

f. Table 6-2 summarizes the quantities by type vehicle which resulted from the TOE proponent analysis. Generally, when a weight class

Table 6-1. Shifts in Fleet Composition

	1/4	5/4 HMMWV	5/4 CUCV	2.5	5	10	TRACTORS
1							
2	26% → 74% →						
3	100% ←	(AMBULANCE) → CARGO	CARGO →	100% 100%			
4			.4% ←	← →	99.6%		
5				2% ←	CGO → TRACTOR →	56%	42%
6	100% ← 18% ←	CARGO	(AMBULANCE) CARGO →	→	100% 82%		
7	SAME AS 2				SAME AS 5		
8		SAME AS 3	SAME AS 3		SAME AS 5		
9	SAME AS 2			SAME AS 4			

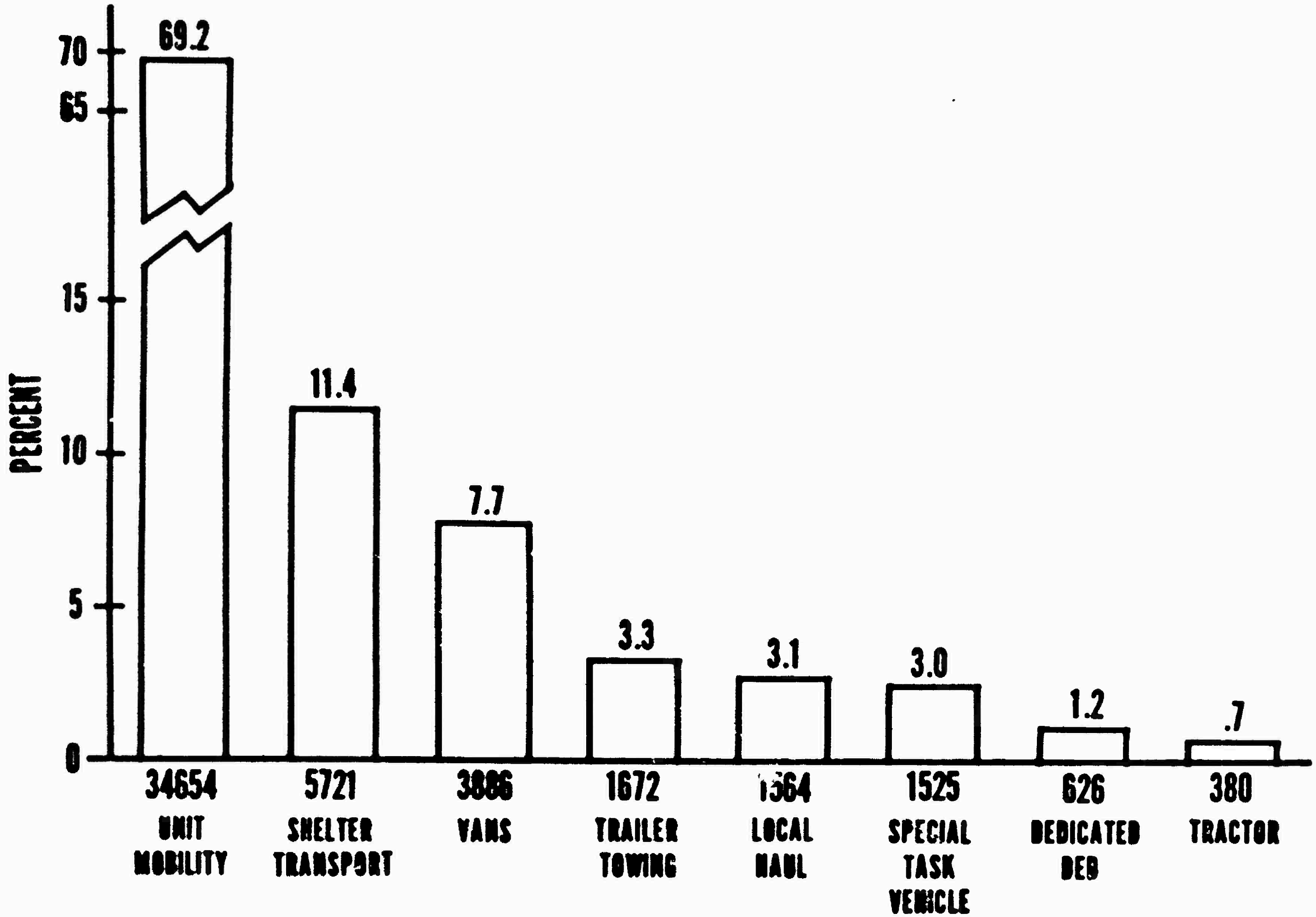

Figure 6-1. 2 1/2-ton truck distribution by primary mission.

Table 6-2. Total Vehicle Requirements by Payload Category

ALT	1/4	5/4	2½	5	10	TRACT	TOT. TRKS	TRAILERS	TOTAL	△
1	111.6	93.7	100.8	59.8	21.7	12.4	400.0	225.9	625.9	0
2	-	198.7	100.8	59.8	21.7	12.4	393.4	177.1	570.5	-55.4
3	129.5	(1) 5.1	166.4	59.8	21.7	12.4	394.9	216.4	611.3	-14.6
4	111.6	94.1	(3) 0.2	160.3	21.7	12.4	400.1	225.9	626	+0.1
5	111.6	93.7	102.8	—	54.1	37.6	399.8	225.3	625.1	-0.8
6	143.5	(2) 11.7	(3) 0.2	209.0	21.7	12.4	398.3	216.4	614.7	-11.2
7	-	198.7	102.5	—	54.1	37.6	392.9	176.5	569.4	-56.5
8	129.5	(1) 5.1	168.4	—	56.1	37.6	396.7	217.1	613.8	-12.1
9	-	199.1	(3) 0.2	160.2	21.7	12.4	393.4	177.1	570.5	-55.4

(1) Significant numbers of weapons carriers required for which there was no substitute vehicle readily available in another payload category.
(2) In addition to weapons carriers, 6,600 ambulances were retained because no substitute was readily available.
(3) Less than 200 2 1/2-ton trucks required by airborne/airmobile units.

was deleted, it went to a higher weight class to satisfy the task requirements.

(1) When a change in fleet mix deletes a weight class and substitutes a heavier payload class (e.g., 5-ton for 2 1/2-ton or 10-ton for 5-ton), it would be expected that the increased cargo capacity would result in fewer total vehicles or, in a worse case, a 1-for-1 substitution. In actuality, the computer automated program, Materiel Acquisition Readiness System (MARS), did not always yield this expected result. For example, the difference between alternative 2 and alternative 9 is that alternative 2 eliminates the 1/4-ton from the base fleet mix, while alternative 9 not only eliminates the 1/4-ton, but also the 2 1/2-ton. In other words, alternative 9 eliminates two weight classes from the base case or, when looked at another way, eliminates one weight class from alternative 2. Alternative 9, as compared to alternative 2, principally is a substitution of 5-ton for 2 1/2-ton vehicles. The automated program was instructed to search each Modified Table of Organization and Equipment (MTOE) for specific Line Item Numbers (LIN) and substitutes another LIN for each one found (i.e., a specific 5-ton LIN for a specific 2 1/2-ton LIN). In those MTOE's, for example, in which a 2 1/2-ton with winch had been substituted for a "plain" 2 1/2-ton or an extra long wheelbase 2 1/2-ton for a "plain 2 1/2-ton, the routine located no vehicles or a lesser number of vehicles of a particular LIN than it should have found. For each "unlocated" vehicle, a larger vehicle LIN was input without an offsetting deletion of the smaller weight class vehicle. Subsequently, the 2 1/2-ton substitute item in the MTOE was identified as a 2 1/2-ton vehicle and replaced with a 5-ton vehicle; therefore, wherever MTOE's contained substitute LIN's, a 2-for-1 exchange erroneously took place rather than a 1-for-1 exchange. This contributed to the situation which occurred in initially compiling the data on the various fleet mix alternatives in which alternative 9 displayed a requirement for 2,200 more vehicles than alternative 2. Examination of this situation, which was the reverse of the intuitively expected result, showed the error source which has been described above. These duplicative substitutions were manually purged from the data shown in tables 6-1 and 6-2.

(2) In some instances, proponents were faced with an alternative which provided no suitable replacement for a special purpose vehicle. This was found to be the case in alternatives 3, 6, and 8 where no 5/4-ton ambulance and no light weapons carrier were available. The numbers of vehicles which could not be practically replaced are circled in table 6-2.

g. Discussion of Mix Alternatives.

(1) Alternative 2 (5/4-, 2-1/2-, 5- and 10-ton trucks).

(a) The purpose of alternative 2 is to determine by comparison with the other alternatives whether the Army can, without adversely impacting combat effectiveness, eliminate the 1/4-ton truck from the fleet and reduce fiscal and manpower costs of acquiring and maintaining the tactical wheeled vehicle fleet.

(b) Examination of table 6-1 shows that in alternative 2, the preferred replacement for the 1/4-ton truck and 1/4-ton trailer combination is a utility version of the 5/4-ton HMMWV on about a 1-for-1 basis. A comparison of vehicle assets is shown at table 6-2 and indicates that alternative 2 requires fewer vehicles than the base case with the difference being primarily 1/4-ton trailers. Operationally, all of the tasks now done by 1/4-ton vehicles could be performed by a 5/4-ton truck.

(2) Alternative 3 (1/4-, 2 1/2-, 5- and 10-ton vehicles).

(a) The purpose of alternative 3 is to determine by comparison with the other alternatives whether the Army can, without adversely impacting on combat effectiveness, eliminate 5/4-ton vehicles from the fleet and reduce fiscal and manpower costs of acquiring and maintaining the tactical wheeled vehicle fleet.

(b) In the absence of a 5/4-ton vehicle, proponents varied in their response for a substitute vehicle between the 2 1/2-ton and 1/4-ton with its associated trailer. The 5/4-ton vehicle was replaced by either the 1/4-ton with trailer combination, or by the 2 1/2-ton vehicle dependent on mission and payload considerations. Table 6-2 indicates a savings in vehicle assets required with the majority of this savings being the elimination of 3/4-ton trailers normally pulled by the 5/4-ton vehicle.

(c) From an operational viewpoint, no suitable wheeled vehicle substitute could be found for the XM966 weapons carrier and for the four-litter ambulances. The 1/4-ton vehicles (2) and trailer (1) combination which the XM966 weapons carrier replaces are considered inadequate by TOE proponents and unacceptable by the Department of the Army (DA). A four-litter ambulance in the 2 1/2-ton class, while not presently in the inventory, could be (according to US Army Materiel Development and Readiness Command (DARCOM)) developed as an alternative to the 5/4-ton vehicle and would be required for a fleet without 5/4-ton vehicles.

(3) Alternative 4 (1/4-, 5/4-, 5- and 10-ton vehicles).

(a) In alternative 4, the study examines a fleet without a 2 1/2-ton vehicle to determine whether tasks usually performed by the 2 1/2-ton family of trucks can be done using other payload categories of vehicles at a savings to the Army.

(b) The 2 1/2-ton truck family consists of cargo, dump, fuel, water, van, and tractor vehicles. Proponents, in transferring tasks normally performed by the 2 1/2-ton vehicle, generally preferred the

5-ton truck whenever a 5-ton type of vehicle existed that would do the job.

(c) A few requirements were placed on the 5/4-ton vehicle family, particularly in airborne units. The proponents had difficulty finding suitable alternatives for the 2 1/2-ton, 1,200-gallon Fuel Tanker (M49C), the M50 Water Tanker, the M805 Maintenance Instrument Repair Shop, and the M109 Shop Van. Although some 5-ton trucks with fuel pods were selected and, in some cases, the 5-ton Expansible Van could be substituted for the M109 Shop Van, it appears that several additional 5-ton vehicles (such as fuel and water tankers and vans) would have to be developed to meet TOE requirements. According to DARCOM engineering estimates, it is feasible to develop 5-ton versions of these vehicles. Overall, table 6-2 shows an increase in assets needed to operate a fleet without a 2 1/2-ton payload truck. A small number of 2 1/2-ton vehicles (less than 200) was required by airborne/airmobile units and could not be replaced without organizational and/or doctrinal changes in those units.

(4) Alternative 5 (1/4-, 5/4-, 2 1/2- and 10-ton vehicles).

(a) Alternative 5 was studied to determine whether or not the Army's tactical wheeled vehicle fleet needs a 5-ton vehicle.

(b) The 5-ton family of vehicles consists of bolster, cargo, dump, stake tractor, tractor-wrecker, wrecker and expansible van types. TOE proponent agencies, in analyzing tasks requiring 5-ton vehicles, selected 10-ton and larger vehicles as alternatives for the most part. Some requirements were placed on 2 1/2-ton vehicles. The result as indicated in table 6-2 is a small decrease in assets needed over a 20-year period.

(c) As in alternative 4, TOE proponents had difficulty in finding suitable alternative vehicle types to replace some of the 5-ton vehicles. The 5-ton tractor is a good example. The tractor, M818, cannot, for mobility reasons, be replaced by an M915 Line Haul Tractor, and the 10-ton tractor 5th wheel design is not compatible with semitrailers normally pulled by the 5-ton tractor. In some cases, an alternative tractor-trailer combination could be substituted. In most cases, a developmental vehicle would be required to replace the 5-ton M818. DARCOM engineers examined the feasibility of meeting special requirements such as the tractor requirement and concluded that a tractor, tractor-wrecker, and expansible van based on the M916 light-medium equipment transporter tractor would have sufficient mobility and could be engineered as alternatives. Additionally, a 10-ton dump truck to replace the 5-ton dump truck was determined to be feasible.

(5) Alternative 6 (1/4-, 5- and 10-ton vehicles).

(a) In alternative 6, TOE proponents analyzed requirements for tactical wheeled vehicles in a fleet without 5/4- and 2 1/2-ton vehicles.

Alternative 6 was the only case examined where two adjacent payload categories of vehicles were eliminated.

(b) TOE proponents selected suitable replacements for 5/4- and 2 1/2-ton vehicles from both the 1/4- and 5-ton vehicles available but encountered all of the problems previously discussed under alternatives 3 and 4, plus great difficulty in finding 5/4-ton ambulance alternatives.

(c) For operational reasons, the 5/4-ton ambulances could not be eliminated in alternative 6. Other developmental types of 5-ton vehicles identical to those used in alternative 4 were considered. One additional developmental vehicle, a telephone maintenance truck, was added for the analysis of alternative 6.

(6) Alternative 7 (5/4, 2 1/2- and 10-ton trucks).

(a) The purpose of alternative 7 was to determine whether a tactical wheeled vehicle fleet without 1/4- and 5-ton vehicles would meet the Army's needs. Unlike alternative 6, the two payload categories eliminated were widely separated.

(b) As expected, the results for alternative 7 can be compared to a combination of alternatives 2 and 5, where the 1/4- and 5-ton vehicles were eliminated separately. TOE proponents made essentially the same choices of alternative vehicles in alternative 7 as in alternatives 2 and 5 with some variation due to the restriction of operating a fleet mix minus two payload categories of vehicles.

(c) Operationally, the same considerations involved in alternatives 2 and 5 appeared in the analysis of tasks for alternative 7. Asset savings, again mostly 1/4-ton trailers, are reflected in alternative 7 as in alternative 2.

(7) Alternative 8 (1/4-, 2 1/2-, and 10-ton trucks).

(a) Alternative 8 considers a fleet without 5/4- and 5-ton vehicles and is similar to alternative 7 in that both alternatives eliminate the 5-ton vehicle.

(b) Alternative 8 may be considered as a combination of alternatives 3 and 5 in which the 5/4- and 5-ton vehicles were eliminated separately. In general, TOE proponents selected suitable alternative vehicles from 1/4-, 2 1/2-, and 10-ton payload categories as in alternatives 3 and 5.

(c) The operational factors considered in alternatives 3 and 5 appeared again in the analysis of alternative 8. Overall, asset reduction, as shown in table 6-3, was achieved over the base case, again due to 3/4-ton trailers eliminated along with 5/4-ton prime movers.

(8) Alternative 9 (5/4-, 5-, and 10-ton vehicles).

(a) Alternative 9 is similar to alternatives 7 and 8 because it is a combination of other alternatives (2 and 4) which eliminated the 1/4- and 2 1/2-ton vehicles separately.

(b) TOE proponents, as expected, analyzed tasks for alternative 9 similar to alternatives 2 and 4. Assets required (table 6-2) reflect the combination of alternatives 2 and 4. Operationally, the TOE proponents encountered the same problems in selecting alternate vehicles for this alternative as they did with respect to the 2 1/2-ton in alternative 4.

6-4. CRITERION OF CHOICE. The study plan (app B) established the need to consider nonquantifiable factors that could impact on the analysis of fleet mixes. During the course of the study, five factors were identified as relevant.

a. Factor A. A lesser number of payload categories should result in (1) increased proficiency and productivity of drivers and mechanics; (2) reduced training requirements in the training base and in units; and (3) reduced parts stockage at all levels of maintenance.

b. Factor B. A larger fleet cargo capacity should provide increased capability for payload dependent tasks, especially to satisfy surges, and provides potential to meet growth in TOE equipment, increased need for survivability, and increased demand for support of more complex material items.

c. Factor C. A greater number of payload categories should assure improved matching of vehicles to mission tasks.

d. Factor D. Fleet mixes which place lesser demands for mechanics are to be preferred. Track and wheeled vehicle mechanics are in short supply in the Army and the situation will most likely worsen.

e. Factor E. Fleet mixes containing lightweight cargo vehicles are more readily deployable both intertheater and intratheater. For example, because of its lighter weight, the 2 1/2-ton is more readily transported in C-141 aircraft than is the heavier 5-ton truck.

6-5. DISCUSSION OF RESULTS.

a. Examination of Tables 6-1 and 6-2 yields the following information:

(1) Elimination of the 1/4-ton truck in alternatives 2, 7, and 9 can be achieved to a high degree by placing 1/4-ton requirements on 5/4-ton payload category of vehicles on about a 1-for-1 basis. A

significant reduction in trailer requirements results from elimination of 1/4-ton trailers along with 1/4-ton trucks. The variances in 5/4-ton requirements in alternatives 7 and 9 are due to elimination of 5-ton and 2 1/2-ton trucks, respectively, as well as the 1/4-ton vehicle. The more restrictive alternative mixes in alternatives 7 and 9 impact, to a small extent, on all payload categories of vehicles.

(2) Alternatives 3, 6, and 8 indicate that TOE proponents could not entirely eliminate the 5/4-ton payload category of vehicles due to nonavailability of required vehicle types. Based on DARCOM engineering estimates, suitable alternative vehicles (in other payload categories) could be developed using vehicle chassis currently programed for the fleet for most requirements; however, HMMWV type weapons carriers required in alternatives 3, 6, and 8 and for the ambulances needed in alternative 6 could not be replaced.

(3) Elimination of the 2 1/2-ton truck in alternatives 4, 6, and 9 can be achieved except for a small number of 2 1/2-ton trucks needed by airborne and airmobile units. The bulk of the 2 1/2-ton vehicles not replaced in these alternatives are specialty vehicles, such as the M109 shop van, for which there was no suitable replacement in another payload category. The use of "dummy" replacement vehicles (considered by DARCOM to be feasible and by proponents to be suitable) is discussed in chapter 4 of the report.

(4) Elimination of the 5-ton truck in alternatives 5, 7, and 8 can only be achieved by development of additional types of "dummy" vehicles in the 10-ton and tractor categories of vehicles, particularly the dump truck, tractor, tractor wrecker, and expansible van types of vehicles.

(5) The total truck and tractor requirements column indicates no significant difference in alternative requirements for numbers of prime mover vehicles. Significant trailer requirement reductions are indicated for alternatives 2, 7, and 9.

b. Table 6-3, Truck Fleet Cargo Capacity, presents the total capability for load carrying which results from selection of a particular alternative. The totals were calculated by multiplying the nominal payload of the vehicle class, times the number of vehicles of that class in the fleet, and summing the totals for each alternative.

Table 6-3. Truck Fleet Cargo Capacity (thousands of tons)

Alternative	1/4	5/4	2 1/2	5	10	Totals
1	27.9	117.1	252	299	217	913
2	--	284.4	252	299	217	1,016.4
3	32.8	6.4	416	299	217	971.2
4	27.9	117.6	--	801.5	217	1,164
5	27.9	117.1	257	--	541	943
6	35.9	14.6	--	1,045	217	1,312.5
7	--	284.4	256.3	--	541	1,045.7
8	32.8	6.4	421	--	561	1,021.2
9	--	250	--	807.5	217	1,274.5

c. Application of Nonquantifiable Factors.

(1) The lesser number of payload categories found in alternatives 7 and 9 tend to favor them for factor A.

(2) Alternative 1 (base case) with its greater number of payload categories and large numbers of 2 1/2-ton and lighter cargo vehicles favor it for factors C and E.

(3) The larger truck fleet capacities of alternatives 4, 6, and 9, shown in table 6-3, favors them for factor B.

(4) From figure 5-2, the lesser demands for mechanics in alternatives 2, 7, and 9 favor them for factor D.

CHAPTER 7

UNCERTAINTIES AND SENSITIVITIES

7-1. INTRODUCTION. The purpose of this chapter is to analyze the impact of uncertainties on study results and the sensitivity of study results to changes in the data and factors contributing to those results.

7-2. UNCERTAINTY OF AMMUNITION EXPENDITURE IMPACT ON STUDY RESULTS.

a. Early in the study, the Study Advisory Group (SAG) directed that the validity of Table of Organization and Equipment (TOE) tasks requiring tactical wheeled vehicles be analyzed in detail for selected units. The results of the analysis indicated that TOE with changes to incorporate the XM1 and Infantry Fighting Vehicle/Cavalry Fighting Vehicle (IFV/CFV) in armor and mechanized infantry units were valid as was the field artillery requirement for additional trucks needed to provide fuel and ammunition. The net increase of 1,608 vehicles for those units studied (per US Army Logistics Center (USALOGCEN)) was required to support increased ammunition expenditures as documented in the Ammunition Initiatives Task Force (AITF) Study, plus changes in ammunition expenditures expected due to introduction of emerging weapons systems and particularly the reorganization of FA 155 howitzer battalions to 24 howitzers, an increase of 6. Additionally, the increased use of high-volume, low-weight missile munitions, such as the TOW and DRAGON, impacted on vehicle requirements.

b. The accuracy of the Army's requirements for tactical wheeled vehicles, as well as its requirement for forces is impacted by ammunition expenditure rates. In combat battalions, such as armor, mechanized infantry and artillery, ammunition expenditure rates, limited weapon system ammunition carrying capacity, support flexibility needs, and resupply timing, all impact on the number of trucks needed in those units to maintain combat effectiveness. These factors were used by Training and Doctrine Command (TRADOC) proponent agencies to structure their TOE. In particular, the ammunition expenditure rates indicated in table 7-1 were used in TRADOC scenarios as a basis for determining trucks needed in battalion units. These rates must be considered in determining a battalion's truck requirements. The distribution rate shown is an average expenditure rate reflecting noncommitted battalions and is useful in planning for support of a division force. The distribution rate figure is consistent with division ammunition expenditure rates published in the recent Combat to Support Balance Study (CSBS) completed by the Concepts Analysis Agency (CAA). The 2,000-STONS-per-day committed rate for a division assumes that every battalion in the division is expending at its committed rate. The AITF study points out that such a rate is 230 percent of the rate compiled by using FM 101-10-1 (Staff Officer's Field Manual: Organizational, Technical and Logistical Data Unclassified Data). The AITF study also provides a figure of 3,450-STONS-per-day for an armored division slice.

Table 7-1. AITF Study.

Type Bn	# Per Div (Armd - Mech	Distribution	Expenditure Rates (STONS) Committed	Surge
Tank/ACS	6-1/5-1	39	54	202
Mech Inf	5-6	19	31	87
155 How	3-3	309	407	635
8" How	1-1	183	244	613
TOTAL				
Armd Div		1,478	1,998	4,367
Mech Div		1,458	1,975	4,252

c. In summary:

(1) Ammunition expenditure rates do not impact the comparison of alternatives in this study.

(2) Ammunition expenditure rates supporting development of TOE requirements for tactical wheeled vehicles are based on AITF study rates and are consistent with the CSBS study rates.

(3) Accuracy of study alternative requirements will be affected by significant changes in ammunition expenditure rates.

7-3. UNCERTAINTY OF REQUIREMENTS FOR TACTICAL WHEELED VEHICLES, 1987-2001.

a. The study uses a 20-year (1982-2001) program cost to compare alternatives. The 20-year program cost was used in order to capture the costs of vehicles with varying useful lives in addition to capturing the total cost associated with acquisition and support of the Army's tactical wheeled vehicle fleet. The Army's projection of vehicle requirements does not extend past 1986. In the study, the 1986 requirements were projected out to 2001 in order to establish the Authorized Acquisition Objectives (AAO) for each year. There is uncertainty that requirements in 1987-2001 will remain constant with respect to the type and number of vehicles needed. Although not completed, Division 86 studies indicate that the types of vehicles needed will not change significantly but quantities will.

b. Program costs for each alternative were discounted at 10 percent per year. This procedure allows comparison of opportunity costs and also serves to weight the early years in each alternative where requirements are more accurately known.

7-4. UNCERTAINTY OF WARTIME ACTIVE REPLACEMENT FACTOR (WARF).

a. Wartime Active Replacement Factors (WARF) used in the requirements generation phase of the Materiel Acquisition Readiness System (MARS) model are generated by the CAA, approved by Headquarters, Department of the Army (HQ DA) and are provided to the Research, Development and Acquisition Information System Agency (RDAISA) for use in the MARS model.

b. The CAA generates the WARF based on simulations of forces equipped with the currently planned tactical wheeled vehicle fleet. From this, the currently planned FY 86 distribution of the types of vehicles in the fleet is determined. The major contributing factor to the attrition rate for each type of vehicle is its location on the battlefield.

c. The use of factors based on the current distribution of vehicle types in the fleet introduces an error into the calculation of the total requirement; for example, the attrition rate for 5-ton vehicles is about 5 percentage points higher than the attrition rate for the 2 1/2-ton truck because the bulk of 5-ton vehicles are used in combat and combat support units operating well forward. The preponderance of the 2 1/2-ton trucks, however, are in combat support and combat service support units further to the rear. In alternative 4, most 2 1/2-ton trucks were replaced by 5-ton vehicles and the calculation of war reserve stocks needed was, thus, higher due to the increased attrition rate for 5-ton trucks. The correct attrition rate for a fleet, such as alternative 4, should be between the 2 1/2- and 5-ton attrition rates. The maximum difference (5%) of the requirement for 100,000 5-ton trucks in alternative 4 is 5,000 vehicles. A comparison of alternatives 4, 6, and 9 showed that reduction of 5,000 5-ton trucks would not affect the comparative ranking of alternatives due to numbers of vehicles needed or manpower and program costs.

7-5. SENSITIVITY OF PROGRAM COSTS TO EXTENSION OF VEHICLE USEFUL LIFE. The 20-year program costs of the alternatives depend on the status of assets in the alternative fleets. The cost of life extension versus the cost of procuring new vehicles and the cost of Operating and Support (O&S) for the extended fleet versus O&S with new Reliability, Availability, and Maintainability (RAM) improved vehicles was examined for alternative 1 (base case) by extending the useful life of vehicles in the fleet by 25 percent. This excursion indicates an 8 percent reduction in overall program costs in the base case extended life due to the reduction in procurement costs. This reduction is about 16 times larger than increases in O&S costs for the extended life fleet. Data to support the increased cost of maintaining overage vehicles was not available but would tend to reduce any savings in procurement costs. Additionally, the combat effectiveness of Army units equipped with overage vehicles would be degraded.

7-6. SENSITIVITY OF ALTERNATIVE PROGRAM COSTS TO CONTRIBUTING COST FACTORS.

a. The major contributing factors to 20-year program costs are indicated in table 7-2 for alternative 1, the base case.

Table 7-2. Cost Factors By Percentages - Base Case

	Development	less than one-tenth of a percent
	1st and 2d Dest Trans	3%
	Acquisition	38%
TOTAL	Procurement	41%
	Repair parts, POL Modification	14%
	Driver	19%
	Mechanics, Indirect	26%
TOTAL	O&S	59%

b. A comparison of alternative program costs in table 7-3 shows that the alternatives 4 and 6 program costs are affected by increased O&S costs over the base case and that alternatives 5, 7, and 8 program costs are affected by increased procurement costs over the base case. Alternatives 4 and 6 both eliminate the 2 1/2-ton truck from the fleet and replace it with 5-ton trucks at increased procurement and O&S costs. The O&S cost increase in each case is about twice the procurement increase. In alternatives 5, 7, and 8, 5-ton trucks are replaced by 10-ton vehicles. In these alternatives, the increased procurement cost outweighs all savings or increases in O&S costs. Based on the above comparison, procurement and O&S costs may individually or collectively contribute to cost increases/decreases over the cost of alternative 1.

Table 7-3. 20-Year Program Cost Comparison (Constant $ B)

	PROC + RDTE		O&S		TOT FY 82		DISCOUNTED	
1	26.78		43.26		70.04		33.07	
2	27.00	+0.22	42.02	-1.24	69.02	-1.02	32.74	-0.33
3	27.09	-0.31	44.13	+0.87	71.23	+1.20	33.82	+0.75
4	27.85	+1.07	45.80	+2.54	73.65	+3.61	35.98	+2.91
5	32.56	+5.78	43.64	+0.38	76.20	+6.16	36.17	+3.10
6	28.01	+1.23	47.13	+3.87	75.14	+5.10	36.37	+3.30
7	32.76	+5.98	42.43	-0.83	75.19	+5.15	35.86	+2.79
8	32.98	+6.20	44.50	+1.24	77.48	+7.44	36.83	+3.76
9	28.06	+1.28	44.43	+1.17	72.49	+2.45	35.72	+2.65

c. A generalized summary of the vehicles studied and their costs is presented in table 7-4. Costs are adjusted to a 20-year program based on the standard useful life.

Table 7-4. 20-Year Estimated Program Costs by Vehicle Type

PAYLOAD CAT	SSN	AAO	USEFUL LIFE	$/EA	ADJUSTED PROC	ADJUSTED* O&S	ANNUAL* O&S
1/4	D15102	111K	12 years	$ 13K	22K	51K	$ 2.53K
5/4	D11103	53K	7 years	$ 13K	39K	42K	$ 2.1K
HMMWV	D15303	27K	12 years	$ 24K	40K	50K	$ 2.48K
2 1/2	D13103	89K	15 years	$ 43K	57K	78K	$ 3.9K
5	D14002	23K	20 years	$ 64K	67K	107K	$ 5.26K
	D14004	12K	20 years	$ 79K			$ 5.48
	D14006	14K	20 years	$ 61K			$ 5.45
10	D16201	13K	20 years	164K	164K	116K	$ 5.82K
1/4 Trl	D05800	56K	15 years	$ 2K	2.6K	18.8K	$ 0.94K
3/4 Trl	D06200	30K	20 years	$ 2.3K	2.3K	19K	$ 0.95K

*O&S less driver costs.

d. Table 7-5 shows typical replacement cost details related to alternatives and indicates the following:

Table 7-5. Estimated Vehicle Replacement Costs by Alternative Group

	20-Year Program Cost EA FY 82 Constant $ x 1000 Procurement	Annual* O&S	TOT
(1) Replace 1/4-ton trk w/trlr with 5/4-ton HMMWV Alternatives 2, 7 and 9	$+15.4	$-19.8	$- 4.4
(2) Replace 5/4-ton w/3/4-ton trlr with 2.5-ton Alternatives 3 and 8	- 2.3	+17.0	$+15.7
(3) Replace 2.5-ton with 5-ton Alternatives 4, 6, and 9	+10.0	+29.0	$+39.0
(4) Replace 5-ton with 10-ton Alternatives 5, 7, and 8	$+97.0	+ 9.0	$+106.0

*O&S less driver costs.

(1) In alternatives 2, 7, and 9, replacement of a 1/4-ton truck and trailer by a 5/4-ton High Mobility Multipurpose Wheeled Vehicle (HMMWV) saves about $4,400 per vehicle over a 20-year program. This was derived by comparing 20-year estimated program costs for each vehicle.

(2) In alternatives 3 and 8, replacement of a 5/4-ton truck with 3/4-ton trailer by a 2 1/2-ton truck will cost about $15,700 over a 20-year period with O&S contributing most of the cost.

(3) In alternatives 4, 6, and 9, replacement of the 2 1/2-ton truck by a 5-ton truck incurs a $39,000 cost over a 20-year program with about 75 percent of the cost increase due to higher O&S cost of the 5-ton truck.

(4) In alternatives 5, 7, and 8, replacement of a 5-ton truck with a 10-ton truck incurs an increase of $106,000 over the 20-year program with almost 92 percent of the cost increase due to higher procurement cost of the 10-ton truck.

(5) Driver costs of about $9,000 per driver per year were not considered in the discussion above because driver positions did not change. Mileage differences between vehicle types were not considered in the estimates above.

e. The total O&S cost is heavily dependent on the estimated number of maintenance and indirect personnel per vehicle. The personnel estimates are derived from the Manpower Authorization Criteria (MACRIT). They are contained in AR 570-2 and are based on historical data obtained from the support of vehicle models currently in the field. The MACRIT for a given vehicle is adjusted as experience is gained in its support and could be changed by the introduction of new equipment or other improvement in maintenance efficiency. Since the O&S cost differences among alternatives are largely driven by the maintenance support structure for the alternative, the relative ranking, on a cost basis, is sensitive to the accuracy of the MACRIT data. Approximately 45 percent of the total cost is attributable to the maintenance and indirect personnel. The analysis assumes none of the personnel were officers. A sensitivity excursion of 3 and 5 percent officer maintenance personnel resulted in nonsignificant changes to the total cost.

f. The study considered the distribution of vehicles among theaters as 77 percent in CONUS and 23 percent in forward deployed units. The 23 percent for forward deployed units is actually a composite of 20 percent in Europe and 1 percent each in the Pacific, Alaska, and Korea commands. Based on the results of an excursion, it was concluded that the net distortion, due to the stated distribution of vehicles, was not significant.

7-7. SENSITIVITY OF RESULTS TO ACQUISITION PLANNING.

a. Use of the MARS model to produce the acquisition plan for each alternative examined in the study required several iterations to produce an optimal acquisition plan. This process required US Army Materiel Development and Readiness Command (USADARCOM) acquisition planners to interact with the MARS model to avoid unrealistic buys and to insure that alternatives resulting in cheaper procurement costs were made by the model.

b. The optimization programing available in the model at this time does not adequately address family buys when operating without a funding constraint. Yearly options to force vehicle buys, available in the model, were used by the acquisition planners to cure this problem.

7-8. SUMMARY.

a. Uncertainties.

(1) Ammunition expenditure rates were uniformly applied to all study alternatives and did not bias the comparison of alternatives.

(2) Ammunition expenditure rates upon which requirements are based are consistent with the Ammunition Initiatives Task Force Study and Combat to Support Balance Study rates.

(3) Tactical vehicle requirements for the time period after 1986 cannot be addressed with certainty. Based on Division 86 emerging results, the type of required vehicles will not change significantly; however, total quantities may change.

(4) The impact of Wartime Active Replacement Factor uncertainties does not significantly change the ranking of alternatives.

b. Sensitivities.

(1) Costs are sensitive to extension of vehicle useful life. The adverse impact on effectiveness was not measured.

(2) Study results are sensitive to procurement and operating and support cost differences between various payload categories of vehicles.

(3) Study results are sensitive to acquisition planning.

CHAPTER 8

PREFERRED ALTERNATIVE

8-1. INTRODUCTION. The purpose of this chapter is to synthesize the study results presented in chapter 5, Analysis of Resources, and chapter 6, Analysis of Fleet Mix Alternatives, taking into consideration the uncertainties and sensitivities presented in chapter 7.

8-2. CRITERION OF CHOICE (STUDY PLAN, APPENDIX B). "This study will be essentially a fixed effectiveness variable cost study. Proponent agencies will maintain current capabilities of unit tactical wheeled vehicles when selecting alternative mixes of vehicles. Because of efficiencies due to reductions in numbers and types of vehicles Armywide, it is expected that one or more of the fleet alternatives will be cheaper than the current fleet. One of these fleet alternatives will be selected as the preferred fleet with due consideration of nonquantifiable matters that could impact on preferences."

8-3. NUMBERS OF VEHICLES. From chapter 6, table 6-2, seven of the eight alternative fleets studied, showed reductions in total numbers of vehicles from those found in the baseline (alternative 1 - table 6-2). Three alternative mixes: 7 (-56.5 thousand), 2 (-55.4 thousand) and 9 (-55.4 thousand) clearly are dominant.

8-4. TYPES OF VEHICLES (PAYLOAD CATEGORIES). From chapter 6, table 6-2, only two alternatives were developed with three payload categories: alternatives 7 and 9. All others contained at least four payload categories. It is to be noted that the objective of achieving three payload categories for alternatives 3, 6, and 8 was unattainable due to an inability to maintain fixed effectiveness for all types of units.

8-5. FLEET COSTS. From chapter 5, table 5-2, alternative 2 is the only fleet mix which is cheaper (total 20-year life cycle and total 20-year life cycle discounted) than the baseline alternative 1. It is to be noted that the cost difference between the baseline (alternative 1) and the cheaper alternative is about $330 million (discounted costs) or about 1 percent different from the baseline costs of $33.07 billion.

8-6. REDUCTION OF ALTERNATIVES UNDER CONSIDERATION. Thus, using the quantitative portion of the presented criterion of choice, three fleet mix alternatives are found to qualify.

	1/4	5/4	2 1/2	5	10
Alternative 2	0	X	X	X	X
Alternative 7	0	X	X	0	X
Alternative 9	0	X	0	X	X

8-7. NONQUANTIFIABLE MATTERS. Chapter 6 of the report introduced the nonquantitative factors developed by the study team. These are reported below to assist in developing the preferred alternative.

a. Description of factors.

(1) Factor A. A lesser number of payload categories should result in (1) increased proficiency and productivity of drivers and mechanics; (2) reduced training requirements in the training base and in units; and (3) reduced parts stockage at all levels of maintenance.

(2) Factor B. A larger fleet cargo capacity should provide increased capability for payload dependent tasks, especially to satisfy surges, and provides potential to meet growth in TOE equipment, increased need for survivability, and increased demand for support of more complex material items.

(3) Factor C. A greater number of payload categories should assure improved matching of vehicles to mission tasks.

(4) Factor D. Fleet mixes which place lesser demands for mechanics are to be preferred. Track and wheeled vehicle mechanics are in short supply in the Army and the situation will most likely worsen.

(5) Factor E. Fleet mixes containing 2 1/2-ton and lighter cargo vehicles are more readily deployable both intertheater and intratheater.

8-8. DISCUSSION OF NONQUANTIFIABLE MATTERS.

a. Factor A, lesser number of payload categories, favors the two 3-truck fleet mixes, alternatives 7 and 9.

b. Factor B, larger fleet cargo capacity, favors in order: alternative 9 (1.2745 million tons); alternative 7 (1.0457 million tons); and alternative 2 (1.0164 million tons).

c. Factor C, better matching of mission task to vehicle, favors alternative 2, the only remaining alternative with four payload categories.

d. Factor D, lesser demand for mechanics, favors in order: alternatives 2, 9, and 7 (fig 5-1).

e. Factor E, deployability, alternatives 2 and 7 contain the 2 1/2-ton vehicles which from size and weight considerations should be more readily deployable than the 5-ton vehicles.

8-9. SUMMARY OF NONQUANTIFIABLE MATTERS. From paragraph 8-6 above, three alternatives (2, 7, and 9) were selected using the quantitative criteria. These alternatives were subjected to evaluation using the nonquantifiable factors. The results of the nonquantitative analysis showed that no one alternative was clearly dominant; however, using equal weighing of all nonquantifiable factors, a slight advantage is seen in alternative 2.

8-10. OVERALL SUMMARY. Use of the quantitative portion of the Criterion of Choice finds that of the total nine alternatives, three fleet mixes satisfy one or more of the three quantitative factors; alternatives 2, 7, and 9. Equal weighting of all factors, quantitative and nonquantitative, favors alternative 2 as the preferred alternative.

CHAPTER 9

ESSENTIAL ELEMENTS OF ANALYSIS

9-1. INTRODUCTION. Seven Essential Elements of Analysis (EEA) were identified in the study plan and listed in chapter 1 of the study. These EEA's were considered as the key to the development of study results. Research results have answered each of these questions.

9-2. ELEMENT 1.

a. Element of Analysis: What quantities and mixes of tactical wheeled vehicles are required for mission accomplishment?

b. Analysis Results: The mission of the tactical wheeled vehicle fleet can be accomplished effectively by different combinations of vehicles by varying the number of each payload category vehicle available to perform the mission. All combinations (or alternatives) considered are based on Tables of Organization and Equipment (TOE) effective in 1986 and include the impact of current Training and Doctrine Command (TRADOC)-approved Basis of Issue Plan (BOIP).

(1) The mix of vehicles in the current (base case) fleet includes 1/4-, 5/4-, 2 1/2-, 5-, and 10-ton trucks, with tractors and trailers. To accomplish the mission with this mix of vehicles requires a fleet of 111.6 thousand 1/4-ton, 93.7 thousand 5/4-ton, 100.8 thousand 2 1/2-ton, 59.8 thousand 5-ton, 21.7 thousand 10-ton, and 12.4 thousand tractors. This vehicle mix of 400.0 thousand trucks and tractors has associated with it 225.9 thousand trailers for a grand total of 625.9 thousand vehicles required.

(2) The mix of vehicles in fleet alternative 2 includes 5/4-, 2 1/2-, 5-, and 10-ton trucks with tractors and trailers. This fleet is configured to accomplish the mission without the use of a 1/4-ton truck.

(3) The fleet alternative 3 vehicle mix was configured to eliminate the use of 5/4-ton vehicles; however, no suitable substitute could be made for the XM966 weapons carrier. All other 5/4-ton vehicles were eliminated from the fleet giving rise to increased numbers of 2 1/2-ton and 1/4-ton trucks and 1/4-ton trailers required.

(4) The fleet alternative 4 vehicle mix is configured to accomplish the mission without the use of a 2 1/2-ton vehicle. This configuration gives rise to an increased number of 5/4- and 5-ton vehicles, with the preponderance of increase being 5-ton vehicles.

(5) The mix of vehicles in fleet alternative 5 is configured to accomplish its mission without the use of a 5-ton truck. This configuration gives rise to a small increase in 2 1/2-ton trucks and a large increase in 10-ton trucks to affect the loss of the 5-ton vehicle.

(6) Fleet alternative 6 vehicle mix is configured to eliminate the 5/4- and 2 1/2-ton vehicles. The lack of a suitable replacement for two types of 5/4-ton trucks causes this payload category to remain (in limited numbers) in this fleet mix. The elimination of most 5/4- and all 2 1/2-ton trucks generates a requirement for increased numbers of 1/4- and 5-ton trucks to perform their missions.

(7) Fleet alternative 7 vehicle mix is configured to accomplish its mission without the use of 1/4- and 5-ton vehicles. The elimination of the 1/4-ton vehicle generates increased requirements for 5/4-ton vehicles. The elimination of the 5-ton generates a small increase in 2 1/2-ton and a large increase in the number of 10-ton vehicles required.

(8) Fleet alternative 8 vehicle mix is designed to accomplish its mission without the use of 5/4- and 5-ton vehicles. Limited numbers of 5/4-ton vehicles remain in this fleet, however, because of the lack of a suitable substitute vehicle to perform their mission effectively. The elimination of most 5/4- and all 5-ton vehicles generates increased requirements for 1/4-, 2 1/2-, and 10-ton trucks.

(9) Fleet alternative 9 vehicle mix is configured to accomplish its mission without the use of the 1/4- and 2 1/2-ton vehicles. The elimination of the 1/4-ton truck generates a decrease in the need for 1/4-ton trailers, and an increase in the need for 5/4-ton vehicles. The loss of the 2 1/2-ton vehicle gives rise to an increased number of 5/4- and 5-ton vehicles with the preponderance of increase in the 5-ton vehicles.

9-3. ELEMENT 2.

a. Element of Analysis: What are the development, procurement, and operating costs for 20 years of fleet operations?

b. Analysis Results: Twenty-year program costs were calculated for each alternative in FY 82 constant dollars. The program cost for each alternative includes procurement, development, operating and support (O&S) (to include vehicle driver) and vehicle driver costs. Total costs were discounted 10 percent per year to compare opportunity costs for each fleet mix alternative.

9-4. ELEMENT 3:

a. Element of Analysis: Which alternative fleet will accomplish the mission at the least cost?

b. Analysis Results:

(1) Fleet alternative 2 can accomplish the mission at least cost. Its total 20-year program cost is $69.02 billion. This total discounted becomes $32.74 billion.

(2) The next closest cost-competitive fleet is the base case, at a cost of $70.04 billion. The total discounted cost of the base case is $33.07 billion.

9-5. ELEMENT 4.

a. Element of Analysis: What is the preferred fleet of wheeled vehicles to satisfy the Army's needs based on present organizations? Based on Army 86?

b. Analysis Results:

(1) An analysis based on the quantitative factors found in the study plan criterion of choice shows that three alternative mixes are dominant over others: alternatives 2, 7, and 9. When considering both quantitative and nonquantitative factors, weighting favors alternative 2 as the preferred alternative.

(2) Phase II of the study will conduct a similar analysis of Army 86 organizations to determine a preferred fleet of wheeled vehicles to meet the Army's needs.

9-6. ELEMENT 5.

a. Element of Analysis: For each vehicle type in the preferred fleet, what is the quantity required and the time-phasing necessary to replace existing vehicles in the current fleet as they exceed age/condition criteria for retention?

b. Analysis Results: The procurement plan for the alternatives was developed utilizing the established procedures for procurement planning with the exception that budget constraints were not imposed on the process. See chapter 4 for an explanation of this process. Table 9-1 shows the quantity of vehicles by category required each year to replace projected peacetime losses over 20 years. For each specific vehicle type in the preferred fleet, procurement quantities and time-phasing of needs are displayed in the procurement output of the Materiel Acquisition Readiness System (MARS) model maintained by the Research, Development and Acquisition Information System Agency (RDAISA) at Radford, Virginia.

9-7. ELEMENT 6.

a. Element of Analysis: What acquisition strategy/plan can be developed to support the preferred fleet?

b. Analysis Results:

(1) The acquisition strategy for the preferred fleet takes into consideration all of the considerations normally involved in procurement planning, i.e., vehicle families, multiyear contracts, minimum buy quantities, maximum buy quantities, economy of quantity, and limitation

Table 9-1. Multi-Item Facility Procurement Program

05/07/20 17:05:29 ALTERNATIVE 2

(DOLLAR COST IN MILLIONS)

YEAR	TOTAL PROGRAM COST	M880 ...011103... QTY	M880 COST	2½ Ton ...013103... QTY	2½ Ton COST	5 TON ...014002... QTY	5 TON COST	¼ TON ...015102... QTY	¼ TON COST	HMMWV ...015303... QTY	HMMWV COST	M915 ...015900... QTY	M915 COST	HEMTT ...016201... QTY	HEMTT COST
1982	918.6	0	.0	0	.0	3000	228.3	0	.0	0	.0	3377	201.9	300	52.6
1983	1950.9	0	.0	0	.0	8000	672.1	0	.0	0	.0	3377	201.9	9500	773.9
1984	2900.2	29060	383.1	3000	193.3	8000	615.9	0	.0	3515	99.3	0	.0	9000	1551.6
1985	3980.5	29060	366.0	20000	910.5	8000	585.5	0	.0	19900	396.0	0	.0	6628	1199.8
1986	2319.5	29060	366.4	20000	889.5	8000	603.1	0	.0	19900	399.9	0	.0	0	.0
1987	1815.6	0	.0	20000	993.9	5307	419.9	0	.0	19900	399.1	0	.0	0	.0
1988	1584.2	0	.0	20000	913.8	3139	237.3	0	.0	19900	352.7	0	.0	0	.0
1989	1539.2	0	.0	16901	789.9	3003	215.9	0	.0	19900	398.6	0	.0	0	.0
1990	883.6	0	.0	3000	152.7	4960	331.8	0	.0	19900	399.9	0	.0	0	.0
1991	901.0	0	.0	3000	193.9	4293	327.3	0	.0	19900	397.9	0	.0	0	.0
1992	1126.5	29060	382.9	0	.0	4823	419.3	0	.0	9934	230.1	648	33.1	0	.0
1993	877.6	29060	382.9	0	.0	0	.0	0	.0	0	.0	2219	119.8	471	88.9
1994	736.3	26931	380.0	0	.0	0	.0	0	.0	0	.0	1963	99.9	1026	188.0
1995	93.3	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1996	79.7	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1997	662.9	0	.0	2400	115.1	0	.0	0	.0	7200	185.6	3282	196.8	0	.0
1998	863.0	0	.0	0	.0	3212	256.3	0	.0	11220	271.5	3362	200.9	0	.0
1999	398.8	0	.0	0	.0	0	.0	0	.0	19218	399.1	0	.0	0	.0
2000	1066.7	29060	382.9	9602	216.8	0	.0	0	.0	19252	396.3	0	.0	0	.0
2001	1578.9	29060	382.9	16557	751.3	0	.0	0	.0	19267	398.0	0	.0	309	57.9
TOTAL	25972.9	232291	3059.9	129520	5969.7	63182	4901.7	0	.0	179906	4268.9	17728	1059.2	22229	3862.3

NOTE: Due to computational procedures these costs may show minor variations from other data.

on procurement period for commercial substitute vehicles. All of these constraints and trade-offs were developed and staffed through the TARCOM and TARADCOM acquisition experts and are based on the same criterion normally utilized for development of the tactical vehicle procurement plan for budget submission.

(2) Table 9-1 reflects the acquisition strategy developed to support the preferred alternative. Specific vehicle types that are based on common chassis are categorized in table 9-1 by their highest density body style. The quantity of vehicles along with their costs are displayed for the year in which procurement is required. Those specific vehicles that do not involve family relationships would be procured according to the quantity and time schedule displayed in the procurement output of the MARS model maintained by the RDAISA at Radford, Virginia. The procurement output of the MARS model contains specific quantity, cost, and time-phasing data for every vehicle in alternative 2.

9-8. ELEMENT 7.

a. Element of Analysis: What is the implementation schedule needed to change requirements and authorization documents to reflect study results?

b. Analysis Results: BOIP changes for requirements and authorization documents that reflect the appropriate number and type of vehicles and drivers for each unit have been developed and put on file as "strawman" BOIP documents at the Data Processing Field Office, US Army Combined Arms Center and Fort Leavenworth Combat Developments Activity, Fort Leavenworth, Kansas. These "strawman" BOIP documents will serve to amend TOE to reflect the type and quantities of vehicles and drivers that would be required by implementing any one of the various alternatives. These BOIP would need to be updated to accomplish other changes (e.g., mechanics, etc.) necessitated by the introduction of these changes in number and type of vehicles and drivers. The updated BOIP should be accomplished as part of the normal TOE updating process done by TRADOC agencies.

CHAPTER 10

FINDINGS

10-1. PREFERRED ALTERNATIVE. The study group prefers alternative 2 (5/4-, 2 1/2-, 5-, and 10-ton trucks) as a tactical wheeled vehicle fleet that meets the study purpose of reducing the number and types of vehicles, saving resources (both dollar and manpower), without degrading combat effectiveness of the Army's tactical wheeled vehicle fleet.

10-2. OTHER FINDINGS. The study findings presented are those of the Commandant, US Army Transportation School, and should not be considered as Headquarters, Training and Doctrine Command or Department of the Army policy or guidance unless so stated in approval documents published by that headquarters.

(1) The tactical wheeled vehicle fleet development process, as studied, is a repeatable methodology that generates basis of change for table of organization and equipment and acquisition plans to procure the fleet.

(2) The trend in development of tables of organization and equipment has been to eliminate the 1/4-ton truck, as evidenced by the development of the high mobility multipurpose wheeled vehicle for weapons carrier, ambulance and command and control tasks and by acceptance of the M880 5/4-ton commercial vehicle to perform tasks previously done by the 1/4-ton truck.

(3) When table of organization and equipment proponent agencies are required to select an alternative vehicle, the trend is to select a higher payload category rather than to select two or more smaller vehicles to do the same job. This indicates that the tables of organization and equipment designers have selected the smallest vehicle capable of doing the task in the current fleet. It also indicates careful design of table of organization and equipment to minimize personnel assets needed for tasks.

(4) As discussed in chapter 6, vehicle replacement ratios approached a 1:1 between alternative mixes.

(5) There is a trend toward use of larger vehicles to compensate for growth in the transportation capacity needed for some tasks. An example is the growth of petroleum, oils and lubricants and ammunition requirements due to the XM1 tank, the infantry fighting vehicle, and the cavalry fighting vehicle.